MAY 26 1930

THE GEOGRAPHICAL JOURNAL

Vol LXXV No 5 May 1930

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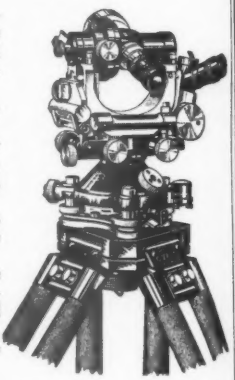

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The
GEOGRAPHICAL JOURNAL

Vol LXXV No 5 R.G.S. *May 1930*

THE ITALIAN EXPEDITION TO THE KARAKORAM IN 1929: *A paper read at the Evening Meeting of the Society on 24 February 1930, by*

H.R.H. THE PRINCE AIMONE OF SAVOIA-AOSTA, DUKE OF SPOLETO

IN 1927 a private committee was formed in Milan to finance an expedition to the Karakoram. With the assistance of the Milanese Section of the Alpine Club and of the Italian Royal Geographical Society, a general plan was outlined, comprising an attempt to climb Mount K_2, the highest peak of the Karakoram, by a group of mountaineers, while the scientific members of the expedition were to investigate the geographical problems connected with the Baltoro Glacier, make stereographic, gravity, and geological surveys, and collect the fauna and flora.

The mountain system which goes by the name of Karakoram lies to the north of Western Himalaya, between the Indus and the Upper Yarkand, or Raskam Darya, and is bounded on the west by the Gilgit river, and on the east by the Shyok. In no other region of the world is there to be found in such a confined space an equally large number of big mountains and glaciers. Besides K_2, ten other peaks ranging from 23,000 to 28,000 feet crowd round the Baltoro glacier. Although the district has been the object of repeated explorations, there remains much to be done both from the mountaineering and the scientific point of view.

The final decisions of the Committee were only reached in the first months of 1928, too late to organize and take out the expedition in the same year, the useful season for work on the high glaciers of the Karakoram being limited to the few months between April and September. It was then decided to carry out a preliminary expedition with the purpose of bringing up and depositing at Askole, the last village on the way up to the glacier, all the materials and provisions which could be got ready in time for the following season. Dr. De Filippi was of great assistance to me with his expert advice, and the experience gained in two expeditions in the Karakoram.

I landed in Bombay at the end of May, where I found a great welcome awaiting me. The Government of India offered every possible assistance, and I

should like particularly to express my obligation to Major Mason, who had explored the Shaksgam Valley in 1926. His valuable information was of the greatest help to me.

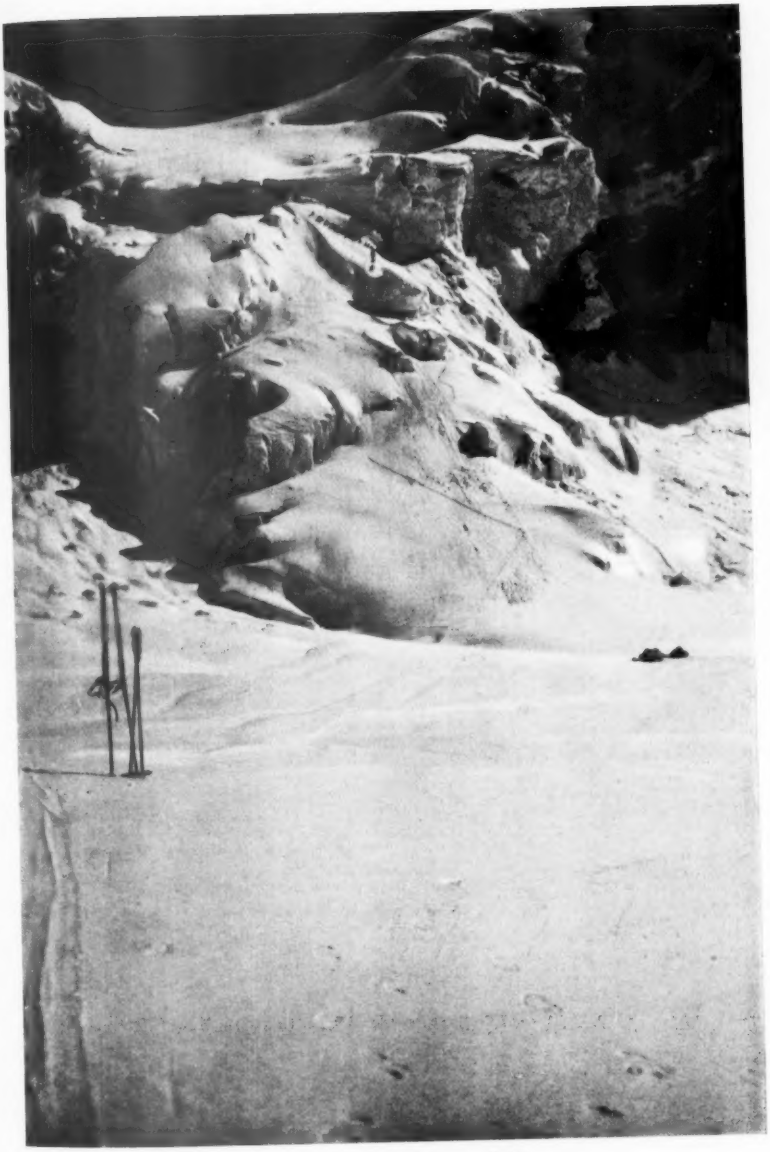
Having reached Srinagar at the end of May, I left it again at the beginning of July, with a caravan of two hundred ponies, making for Skardu, the capital of Baltistan. Two roads lead to Skardu: one over the Deosai plain, and the other by the Sind, Dras, and Indus valleys. We planned to go out by the former and return by the latter, so as to see as much as possible of the country and to get to know the people with whom we would have to deal in the following year. We passed through Skardu, and from there across the Indus and up the Shigar and Braldo valleys, reaching the village of Askole, where we stored 18 tons of material and provisions in huts hired from the lambardar. We then started on the return journey, crossing the Skoro La (16,700 feet), which shortens the distance between Askole and Shigar by three stages. Having travelled by the Indus Valley road, we reached Srinagar in the last days of August. The party then returned to Italy to complete the preparations for the following year.

Meanwhile the Committee had changed the plan of the Expedition, transforming it into a purely scientific one and giving up the idea of attempting the ascent of K_2.

The Expedition finally left Italy in February 1929, travelling straight to Srinagar, where the caravans were prepared without delay. The party consisted of twelve Europeans: Myself in command; Comandante Cugia, second in command, in charge of geophysical and astronomical observations; Dr. Allegri, R.N., medical adviser, entrusted with anthropological researches; Professor Desio, geologist and geographer; Professor de Caporiacco, naturalist; Col. Balestreri, Signori Ponti and Chiardola, mountaineering experts, with two Alpine guides from Courmayeur, Bron, and Croux; Signor Terzano, cinema operator; and Anfossi, wireless operator.

Owing to the great number of loads (nearly six hundred) the caravan was split into three groups, which proceeded separately. The first difficulty we met on our way was the Zoji La (11,230 feet), which at this time of year has to be climbed by the steep narrow gully, exposed to snow avalanches; but fortunately we all got over the pass without suffering any loss, although we were caught by a heavy snowstorm at the top. Skis were very helpful, saving us many hours of heavy tramping for the following two stages. By the end of April we reached Askole, where we found in perfect condition the stores which we had left in the previous year. Here we reorganized the caravan, and enlisted the permanent coolies for the high-mountain work. Five more marches brought us to Urdokas, on a spur of the southern buttress of the Baltoro glacier, which we had chosen as the place for our base camp.

While the supplies were being carried up, Professor Desio made a preliminary exploration of the Dumordo valley, which joins the Biaho a few miles below the front of the Baltoro glacier. Into the upper part of the valley flows the Punmah glacier, which is fed by five principal tributary glaciers, covered by surface moraine up to a height of 14,000 feet. In the lower valley are scattered groups of diminutive huts occupied during the summer months by shepherds. Desio went up the Punmah to the foot of the watershed range, and made a hasty survey



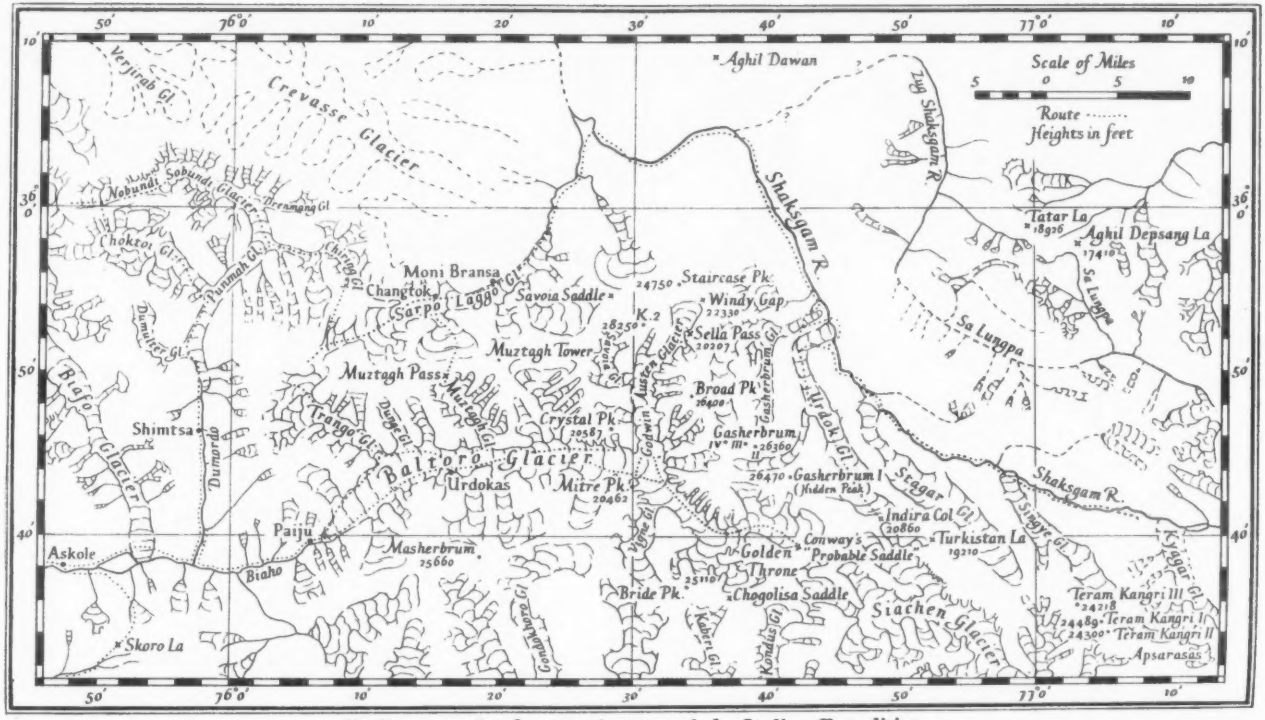
The ascent to the Muztagh Pass

The Sarpo Laggo glacier north of the Mustagh

of the valley and the glacier, collecting geological data and observations on the limits of vegetation, etc.

During the second half of May Professor Desio made two further excursions for geological researches in the valley of the Baltoro. From the Concordia amphitheatre he ascended the northern branch of the glacier, or Godwin Austen, to 18,300 feet, not far from Windy Gap, and later the southern branch to the upper basin. The great pyramid of K_2 appears to be made entirely of gneiss, more or less schistose, while the Gasherbrum group is mainly built of limestone, with occasional fossils, which is continued as far as Hidden Peak, confirming the conclusions arrived at by the expedition of the Duke of the Abruzzi. Meanwhile we were rapidly organizing the base camp, and preparing for an exploration into the Shaksgam valley. The Shaksgam had been first discovered in 1887 by Sir Francis Younghusband, who came into it from the north, over the Aghil Dawan. Two years later he again explored it at its western end. Major Mason, in 1926, explored its eastern, or upper end. We had planned to enter the intervening part of the valley, and connect the two previous explorations by a survey of the portion of the valley hitherto unknown. Sir Francis Younghusband had passed from the Shaksgam valley into the Baltoro, crossing the divide by the Muztagh Pass, which once used to connect Kashmir with Turkistan, but had been abandoned many years ago, owing to changes in the conditions of the glaciers which blocked the way. After Younghusband, only one other European, Herr Ferber, had reached the summit of the Muztagh from the Baltoro, but did not push forward to the other side. We decided to try and reach the Shaksgam by this pass, although the reports were not very encouraging. A first reconnaissance was made by Balestreri and Chiardola, to ascertain whether it would be possible to convey a party of laden coolies over the pass. I received a report from them after ten days. They had been delayed by bad weather. They had tried at first to follow the way described by Sir Francis Younghusband in Major Mason's report; but it led over rocks which they considered too difficult for the porters. Therefore they kept to the right of the col, by a slightly easier passage, although they had to pick their way through the seracs near the top of the col.

As soon as the news reached us, we prepared immediately for the exploration. It was to be carried out by a party of five, with thirty coolies, supported by an auxiliary party of twelve coolies led by another European, which was to advance supplies to a place called Moni Bransa, two days' distance from the top of the pass. This small group, having supplied the main body during the five days' march from the base camp, would still have a small amount of provisions to be left at Moni Bransa, and would then return to the base camp. Thus the exploring party had supplies for twenty-five days, and, in case of emergency, had this small store to fall back upon. The planned itinerary beyond the Muztagh Pass led down the Sarpo Laggo valley, then turned up the Shaksgam valley, north of K_2, allowing for the exploration of the glaciers which flow into the valley, and proceeding, if possible, as far as the lowest point reached by Major Mason in 1926, where he found his way blocked by the snout of the Kyagar glacier. They then would try to find a way over one of the passes to the east of K_2, back into the Baltoro, returning to the base by the Concordia amphitheatre.



Preliminary sketch-map of routes of the Italian Expedition

On June 2 we sent the supplies to the foot of the Muztagh Pass, and on the 6th the exploring party left the base camp. Unfortunately I was taken ill on the way up, and unable to proceed any farther for the time being, so I had to hand over the leadership to Balestreri. With him went Desio, Ponti, and the guide Bron.

They reached the top of the pass in the early morning of June 9. The col, 17,500 feet high, is situated on the eastern side of the upper basin of the Muztagh glacier, and leads to a tributary glacier of the Sarpo Laggo. The descent is easy, and with the help of skis in a few hours they crossed the Sarpo Laggo and reached Changtok on an old moraine covered with grass. Moni Bransa, also situated on the left lateral moraine, was reached next day. Here the auxiliary party led by Caporiacco and Chiardola left the caravan to return to the base, according to plan. The remaining four, with thirty-six coolies, proceeded on their way down, reaching the front of the Sarpo Laggo glacier on June 12. The Sarpo Laggo is a large glacier, and it flows far towards the west, terminating at an altitude of 16,300 feet. Below stretches the valley, very wide, flat, and dotted with clumps of vegetation. In one of these oases, perhaps the Suget Jangal of Younghusband, were found traces of camps, some of them very recent, and a small enclosure of stones, looking like a grave. This oasis, covered with thick bushes with intervening grassy stretches, is a resort for wild asses, or kyangs, and hares. A few miles below the glacier a large tributary joins the valley on the left, filled to near its end by a glacier, the "Crevasse Glacier" of Younghusband. A little farther another, smaller, valley closed by a large moraine, comes down on the right.

The opening of the Sarpo Laggo valley into the Shaksgam, where remains of old camps are again to be seen, was reached on June 13. The junction is marked by an isolated rock, nearly 500 feet high, capped by a stone cairn possibly erected to indicate the old caravan road, from which one can see K_2. The Shaksgam valley above the junction is narrow and deeply cut between high limestone cliffs; below it suddenly opens out and looks almost like a continuation of the Sarpo Laggo.

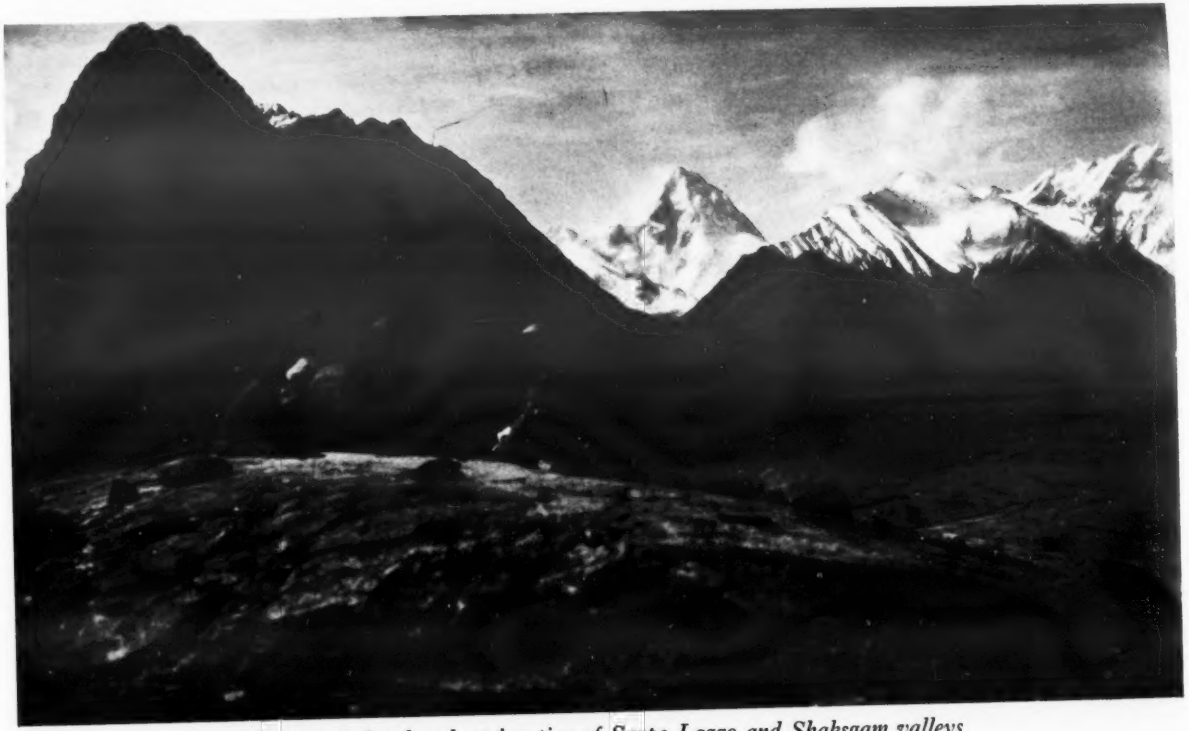
A march of a day and a half along the bottom of the valley, which entailed the wading of the narrow river on several occasions, brought them to the mouth of the small valley coming from the Aghil Dawan. The Shaksgam is sprinkled with small oases, the sides are bare of vegetation, the surrounding mountains have dolomitic shapes with towers, needles, and pinnacles, terraced sides and big accumulations of detritus at their feet. The evening of the 15th they camped on one of the big alluvial fans which lie at the foot of all the side valleys. Above them the snout of the Gasherbrum glacier stretched across the valley; and beyond were visible the Gasherbrum peaks. A few miles below the Gasherbrum a considerable valley opens into the Shaksgam, which is probably to be identified with the Zug Shaksgam of Major Mason. A little lower below it there is a fine oasis watered by a thermal spring. It is the highest oasis of the Shaksgam valley; but its position does not correspond with the Durbin Jangal, which the Indian Survey map places higher, but of which no trace was found. Shortly before reaching the Gasherbrum a kyang was killed, providing some excellent fresh meat for the party. On a rock spur was noticed a heap of stones looking like a signal, which might possibly denote the Gasherbrum Jilga of Younghusband.

On June 18 they tried to find a way round the front of the Gasherbrum glacier; but they were stopped by a deep pool of water, beyond which rose a perpendicular wall of ice. They then climbed the left moraine, and succeeded in crossing the glacier bristling with ice pinnacles to the right moraine, where they camped at the foot of the buttress dividing the Gasherbrum from the Urdok. Next day they reached the Urdok by climbing to a saddle on the said buttress from which the whole glacier could be seen stretching south-west as far as the Indira Col. In the next two days they ascended the glacier, covered with moraine to considerable height, to the steep terminal ice-wall, swept by avalanches, which leads to the col. The weather had changed, and the whole district was covered with a deep layer of newly fallen snow. They had considered for a time the plan of attempting to cross the Indira Col; but, the weather having broken and the supplies being reduced to half, they decided to split the party: Balestreri and Desio proceeding towards the upper Shaksgam with eight coolies, while Ponti and the guide returned to the Baltoro.

A small dump of supplies was made near the front of the Urdok, and the reduced caravan proceeded on the wide flat bottom of the Shaksgam valley. The limestones prevalent lower down continue above the Urdok, and contain a fair number of fossils.

On the evening of the 24th camp was pitched near the next glacier cutting the valley, to which the coolies gave the name Stagar, the Balti word for "many coloured," owing to the alternating strips of ice and moraine. The glacier stops at a distance of about 450 to 500 feet from the opposite side of the valley, leaving an open corridor in which flows the river. Through this, crossing and recrossing the stream, they got beyond the glacier. The characteristics of the valley remain the same. A third protruding glacier was overcome with considerable difficulty. The front reaches the right side of the valley; so they had to traverse it higher up, struggling for hours in the labyrinth formed by ice pinnacles, some of which were over 200 feet high, helping the coolies, who baptized the glacier "Singye," meaning "difficult." The sand deposits above the Singye, and the terraced sides of the valley prove the formation of temporary lakes during the intermittent damming of the Shaksgam by the side glacier. Above the Singye the valley narrows and the river is considerably smaller, and can be crossed by stepping from stone to stone. On the 27th the march was resumed along the big reddish buttress forming the right side of the valley, the Red Wall of Mason. About midday they sighted another large glacier, covered with pinnacles, stretching across the valley, the Kyagar, and they reached it the same evening. Next morning, from the top of a rock on the left side of the valley they had the sight of the whole Kyagar glacier up to the Apsarasas range. Across the glacier, on its right side, they were able to identify the stone signal built by Minchington of the Mason expedition. The Kyagar, which has been minutely described by Major Mason, has the same features as those of Singye. They built a stone signal on their observation point, 16,300 feet high, and hid in it a record of the expedition in a tin box.

The return journey began next day. They recrossed the Singye with the same difficulty but with better weather, which allowed them to see the upper part of the glacier and the majestic group of Teram Kangri which rises at its head. They passed round the front of the Urdok, which does not block the



K2 from isolated rock at junction of Sarpo Laggo and Shaksgam valleys

The Urdok glacier

valley, leaving an open space for the river. The weather, uncertain and foggy, prevented them from pushing an exploration into the Zug Shaksgam, so as to connect with Mason's survey of the valley.

They cut the corner between the Sarpo Laggo and the Shaksgam valleys by climbing over the right buttress of the Sarpo Laggo. Just beyond the top K_2 was distinctly observed. They also noticed some well-preserved bits of an old caravan path, and everywhere remains of old camps. On July 9 they arrived at Moni Bransa, where the depot of supplies had been made. From there they proceeded toward the upper part of the Sarpo Laggo glacier, reaching on the third day the saddle at the head of the valley, 18,500 feet high, from which they pushed on a short way beyond the watershed in the upper basin of a large glacier tributary of the Baltoro, which, according to Conway's map, they believed to be the Dunge glacier. Wishing to return to the base camp in the prearranged time, they did not attempt the new way which was opening up, but returned on the Sarpo Laggo, and, having recrossed the Muztagh, reached Urdokas on July 14.

While my companions were carrying out this task, as soon as I had sufficiently recovered, I turned my attention to the Upper Baltoro, where another geographical problem remained to be solved. In Sir Martin Conway's map of 1892 there is mentioned a "probable saddle" in the upper basin of the Baltoro glacier. Professor Desio, in his excursion of the latter part of May, had climbed part of the way towards it. It seemed to me worth while to carry out a closer investigation. Owing to the absence of most of our coolies with the exploring parties beyond the Muztagh, I was unable to leave the base camp before the end of June. I then went up to Concordia, where for a few days I was engaged in survey work. Then a heavy snowstorm confined us to our tents for six days. Finally, on July 9, the weather having cleared, I set out with Ponti, the guide Croux and sixteen coolies. Three days of difficult march over the glacier covered with soft snow, where skis proved very useful, brought us to the foot of the saddle which was our aim. Some of our coolies were tired and suffering from mountain sickness; but with a little persuasion they were induced to carry on.

The morning of the 12th we started off at 4 a.m. For the first few hours we proceeded easily over the hard frozen snow; but later, with the rising of the temperature, our progress became slower. The incline is very steep; and at times we were compelled to make long détours to avoid deep crevasses and dangerous seracs. Our coolies, although heavily laden, followed us fairly well. Not far from the summit a long and gentle slope allowed us to use our skis; and shortly after noon we reached the crest. To the east of us rose a range of steep high mountains extending eastwards to a snow saddle, which connects it with an isolated peak in the shape of a pyramid. This saddle, which appeared to be at the same height with ourselves, is impassable, owing to a cascade of seracs about 900 feet high, capping a perpendicular wall which extends to the bottom of the valley. To the south-east we saw a large group of mountains. Between these and the pyramid peak just mentioned flows a glacier. Until my observations have been worked out and allow me to identify the groups of mountains, I cannot positively assert that the valley we looked down into is the Kondus.

While waiting for the coolies to bring up the photo-theodolite I took my compass bearings; and it was fortunate I did so, for a few minutes later the clouds had blotted out the horizon, making further observations impossible.

We pitched out tents on the col itself, at an altitude (recorded by altimeter) of about 20,000 feet. During the rest of the afternoon we were only able to get occasional glimpses of our surroundings; and later a snowstorm broke, which lasted the whole night. Although we three Europeans were in good physical condition, the coolies were obviously very depressed and worn out; so that I did not think it advisable to remain longer at this height, and decided to return down to the valley. The descent was complicated by a dense fog. We reached the camp at the foot of the pass in the early afternoon. The skis came in very useful next day, when we covered in three hours a distance which had taken us two days' march to cover on the way up. On our way back to Urdokas we made occasional halts to complete the survey of the Baltoro.

Here I should like to make a short parenthesis to suggest that the col which we reached at the head of the Baltoro should hereafter bear the name of Conway's Saddle, as in the whole field of his pioneer exploration work there is as yet no record of his name. If European names are allowed to survive, I hope that the Royal Geographical Society and the Survey of India will consider this suggestion.

Our work on the Baltoro was finished, and it was time to prepare for the return. It took us ten days to strike camp, and by the end of July the expedition was on its way back.

During a lengthy stop in Askole for some scientific observations and to rearrange the loads and organize the transport, Ponti and Desio made a further exploration of the Trango and Punmah valleys.

Desio was anxious to reconnoitre from the south the easy saddle at the top of the Sarpo Laggo, which he had reached with Balestreri on their way back from the Shaksgam. He had then the impression that it led on the Baltoro side into the Dunge glacier. He therefore proceeded with Ponti to ascend the Dunge; but they found that the valley ended in a *cul de sac* a few miles above its mouth. They then turned lower down to the Trango glacier, another tributary which reaches the Baltoro from the north. They found a fairly wide valley, enclosed by steep walls crowned by lofty rock pinnacles. The glacier is covered with moraine material. The long valley ends in a vast upper glacial cirque, on the east of which they recognized at once the ice slope which rises with an easy gradient and few crevasses to the Sarpo Laggo saddle. Having thus connected with the former survey, they joined the expedition at Paiju, at the foot of the Baltoro.

They then turned their attention to the Punmah valley. This valley had been partly explored in 1856 by Adolph Schlagintweit; in 1861 by Col. Godwin-Austen; and in 1887 by Sir Francis Younghusband, all bound for the so-called New Muztagh pass, at the head of the Chiring glacier, an eastern tributary of the Punmah, which, after the old Muztagh had become impracticable, had been used for a time by the natives to cross into Turkistan. Only Godwin-Austen nearly reached the pass.

From a camp at the confluence of the Chiring with the Punmah, Desio and Ponti in two days reached the upper basin of the Chiring at an altitude of 18,000

feet, in view of a pass which they had already observed from the Sarpo Laggo. This col, probably to be identified with the New Muztagh, can be easily reached and crossed with skis. Having returned to the foot of the Chiring, they proceeded up the Punmah towards its large north-western tributary, Nobundi Sobundi. The upper Punmah is flat, bare of moraine and perfectly easy. Here and there they observed feathers and bones of birds, including the carcase of a large vulture, the victims of cold, starvation, and snowstorms. The Nobundi Sobundi was ascended to the upper end, where an ice wall about 60 feet high leads to a small saddle marked by a rock pinnacle shaped like a blade. They stood upon this saddle (17,000 feet) on August 14 and saw that it led south into the next large tributary of the Punmah, the Choktoi glacier. Desio also climbed another saddle at the head of the glacier, 18,300 feet high, which leads into the upper basin of the Biafo glacier. They then crossed the col first explored into the Choktoi glacier, following which they returned on the Punmah and so back to Askole. They had completed a topographical and geological survey of the Punmah.

The return journey of the expedition was uneventful, except for some difficulty in crossing the Indus, still swollen by the flood which had happened a few days before, due to the bursting of the Shyok dam. We crossed the Deosai plateau and arrived at Srinagar in the first week of September.

Having thus outlined a sketch of the expedition, I shall briefly summarize the results achieved in the various fields of research, although definite conclusions will only be possible when the elaboration and careful study of the data and material collected can be completed.

In the field of exploration the excursions made by Professor Desio and by myself have covered the whole extent of the Baltoro glacier and of both its northern and southern upper branches.

Col. Balestreri and Professor Desio have surveyed the Sarpo Laggo glacier and the saddle which connects it with the Baltoro basin, ascertaining its easy accessibility from both sides. The Shaksgam valley has been explored from the Sarpo Laggo junction up to the Kyagar glacier. The portion of the valley lying between the foot of the Urdok and that of the Kyagar had never before been traversed.

Professor Desio with Ponti explored the Dunge and the Trango glaciers, northern tributaries of the Baltoro, and proved the existence of a comparatively easy saddle between the Trango and the Sarpo Laggo. The Trango glacier is much longer than it had been formerly believed. They also explored the Punmah glacier and its tributaries, ascertaining the accessibility of the New Muztagh pass and its topographical position. They also found a saddle at the head of the Nobundi Sobundi, one of the largest tributaries of the Punmah, which gives access to the upper basin of the Biafo.

Turning to physical geography, Professor Desio will be able to describe the characteristics of several large glaciers, including those that flow on the northern slopes of this portion of the Karakoram into the Shaksgam valley. He has also made interesting observations on the configuration of the mountains in connection with their geological structure and the disintegrating action of the atmosphere.

With the help of my fellow-members of the expedition I completed a survey of the Baltoro basin with the Wild photo-theodolite. The position of our station in Urdokas base was accurately fixed by astronomical observations and by wireless time signals, and connected with the summit of K_2, which is included in the triangulation of the Survey of India. Gravity pendulums were swung at this station, and also in Askole. We were prevented from repeating them in Shigar owing to the bad weather.

Complete series of magnetic determinations were made along the whole way. Some of these magnetic stations were in localities where magnetic data had already been collected by the De Filippi expedition of 1913–14; and the comparison of results will lead to conclusions about the secular variation.

Professor di Caporiacco has made extensive zoological and botanical collections: 20,000 of the fauna, and over 2000 of the flora. The detailed classification will tell how many different species were found, and their distribution. Many specimens of water containing plankton and benthos, animal and vegetable, were also collected.

For the first time a systematic geological survey of the district explored was made by Professor Desio. Up to now the geology could only be incompletely surmised, from small collections of stones and rocks brought back by Sir Martin Conway and the Duke of the Abruzzi's expedition. Of great interest is the discovery of fossils in the basin of the Baltoro and of the Punmah, and especially at the foot of the Gasherbrums. Though slightly deformed by orogenic movements, these fossils will enable us to fix the age of the limestone enclosed in the crystalline series of the Karakoram. The Shaksgam valley also yielded a large number of fossils. It is superfluous to point out that in this district, mainly consisting of rocks of marine origin, we had as yet no geological information.

Finally, Dr. Allegri collected a series of anthropological measurements and photographs, which are a further contribution to the anthropological observations of Dr. Ujfalvy, and especially to those of Professor Dainelli.

DISCUSSION

Before the paper the PRESIDENT (Colonel Sir CHARLES CLOSE) said: His Royal Highness the Duke of Spoleto has most kindly consented to give us an account of the results of the Italian Expedition to the Karakoram. The expedition took place last year, and His Royal Highness was the leader. I need not remind you that that enormous mountain mass to the north of the Western Himalaya, roughly 100 miles from Srinagar at its nearest point, has been the subject of exploration by most distinguished travellers, amongst whom one may mention Godwin-Austen, Sir Francis Younghusband, Sir Martin Conway, the Workmans, H.R.H. the Duke of the Abruzzi, uncle of our lecturer to-night; Dr. Longstaff, Dr. Filippo De Filippi, General Bruce, Major Mason, Mr. and Mrs. Visser, and Captain Morris. Now amongst those expeditions no work of a more valuable character has been done than that by the Italian Expeditions, and the Duke of Spoleto is carrying on the excellent tradition which was set by H.R.H. the Duke of the Abruzzi and Dr. De Filippi. To-night His Royal Highness will tell us what has been the result of the latest expedition, by the leadership of which he has enrolled himself in the goodly company of Italian explorers in the Karakoram.

Looking up the Baltoro glacier: Conway's saddle hidden by mountains on right

Looking east from Conway's saddle

H.R.H. the Duke of Spoleto read a telegram of greetings sent by General Vacchelli in the name of the Royal Italian Geographical Society, and then the paper printed above, and a discussion followed.

Sir FRANCIS YOUNGHUSBAND: First of all, I should like to congratulate His Royal Highness on the great skill with which he led the expedition. The Italian expeditions to the Himalaya have gained a reputation for perfect organization. I was very much struck when I was in Kashmir with the organizing ability of His Royal Highness' uncle, the Duke of the Abruzzi. And the Italian expeditions are not only well organized and well planned, but they have also the supremely valuable characteristic of being able to make use of the people of the country, the Baltis, the people of the highest valleys. Their ability to use these people enabled them to get into those very remote parts which, without their assistance, would have been inaccessible.

Personally, I did not think it would be possible to take such a large party into that very remote region of the Shaksgam valley. I have visited that region twice, and on each occasion was the only European. I was of opinion that probably His Royal Highness was making a mistake in taking a large party into that rugged region you have seen on the screen. But he has been able to overcome the difficulties. He has got his geologists, surveyors, and others there, and has brought back a thorough scientific record of the country. To me the most valuable is the collection of photographs. The region which the expedition explored is one of the most remarkable in the whole world. Probably no part of the Himalaya is more rugged than that around K_2, especially on the northern side in the Shaksgam. It is no good bringing back to a London audience a map alone, valuable as that is; we want to know something of what the country is like, and the photographs we have seen give a certain idea of it. They are about the best that have been taken, but I think even those who took them will admit that, after all, they only give perhaps a slight idea of the magnificence of the region.

You can well believe the interest with which I sat here this evening and watched the photographs and heard the description of the country, having visited it so many years ago; and I should like to say a word with regard to the Muztagh Pass, which I crossed in the year 1887, and of which you saw a most beautiful photograph this evening. As I looked at that I felt quite certain that it has altered very considerably in the last forty years. The great mass of ice has advanced. It had evidently come down a good deal farther when I was there in 1887 than when my man Wali had crossed it twenty-five years before. Now it has come down farther still. In my day, at any rate, we thought the glacier was impassable, and so we crossed the pass where His Royal Highness indicated, down the rugged part which was ascended by the German climber, Ferber, about fifteen years after me. Now the ice-fall seems to be more or less accessible. It did not look very nice going. But anyhow the Italians were able to get up it and over the Muztagh Pass and down the Sarpo Laggo glacier into the Shaksgam valley. Before reaching the valley they passed the Suget Jangal, which apparently is much as in my time, a resort of wild asses and hares, and there the expedition found the remains, probably, of my camp.

I have been talking with Professor Desio, and I am sorry to say his party missed a most beautiful view of K_2 up the valley near Suget Jangal. Professor Desio explained that, unfortunately, the day they were near Suget Jangal it was cloudy. I remember perfectly well as I came round the corner and the view of K_2 burst on my sight I was almost overwhelmed; it was so stupendous. On the other hand, I unfortunately crossed the ridge between the Sarpo Laggo and the Shaksgam valley after dark, and so was unaware that from it it is possible to get that magnificent view of K_2 which has been shown to-night.

Looking east from Conway's saddle

Then in the Shaksgam valley is the Durbin Jangal, which I so named because I lost a pair of field glasses there. Apparently the Italian Expedition neither found my field glasses nor the Jangal. All seems to have been swept away. I am sorry, because I took great care to fix its latitude and longitude.

Then they came to that tremendous glacier coming down from the Gasherbrum right up against a cliff on the other side. I was fortunately at that spot later in the season, when there was not so much water, so I was able to go between the glacier and the mountain side. Not only that, but I took ponies along there and up the Urdok glacier almost to the foot of the pass at the head, which I think is called the Indira pass.

As to the Baltoro glacier and the southern side, a very important point which has been cleared up by the Italian Expedition is that the northern side of the Karakoram Himalaya can be reached not only by the Muztagh Pass but probably, as His Royal Highness has pointed out, by other passes—by the Nobundi Sobundi pass, and by the other pass or saddle which they explored from the southern side. What that means is that it is possible to get from the Indian side into the Shaksgam valley on the north comparatively easily. And that having been done by the Italian Expedition I hope use will be made of the information they have obtained, because the region on the far side of the Karakoram is, as you have seen from the photographs, one of the most splendid regions in the whole world. If we could only get a photographer up there by himself—it need not be a great expedition or numerous; it might be just one or two men with some good porters, who can get over one of those passes and down the Shaksgam valley. I should like to see them ascending the spurs on the Aghil range opposite K_2 and looking about from there for the best view-points from which to photograph K_2, Gasherbrum, and all those magnificent peaks, including those first noticed by Sir Martin Conway from the southern side. They would do something not only for geographers but also for every mountain lover. I wish, in conclusion, to congratulate you, Sir, on the magnificent photographs you have shown and on the lecture you have given us.

Professor DESIO: I thank the President for the kind invitation to speak, but it is not easy for me to summarize in a few words the geographical and geological results of the expedition. The regions explored south of the watershed of the Karakoram are mostly constituted of crystalline and generally metamorphic rocks, and on these the most extensive outcroppings are the gneisses and the granites, but the country is crossed by a belt of limestone and shales, more or less metamorphic, in which I was able to discover fossil remains of the Carboniferous age. On the northern side of the Karakoram there are rocks of marine origin, but in the Shaksgam valley the sedimentary rocks also outcrop with normal facies generally of calcareous material. In this area the fossil remains are very numerous and well preserved, and belong to the Permo-Carboniferous age.

Enclosed in this crystalline series was limestone, but the tectonic structure was very faulted. I was able to recognize two anticlinal zones. I also observed evidence of the old extensions of the glaciers during the Ice Age in the Baltoro and Shaksgam valleys. Lastly, I collected data on the recent limits of the fronts of all the existing glaciers.

Sir GEOFFREY CORBETT (Himalayan Club): I first came into contact with the Italian Expedition about two years ago, when His Royal Highness the Duke of Spoleto, with characteristic modesty, arrived almost unannounced at Bombay. Some few of us at Simla were at that time occupied in trying to found the Himalayan Club, and one of its founders was Lord Irwin, the present Viceroy, who at once asked the Duke to come to Simla and talk things over with us. Major

Kenneth Mason, to whom His Royal Highness has so kindly referred, was at Calcutta at the time, and we got him up to Simla, ready to meet the Duke and Commander Cugia; and Major Mason spent the best part of one day telling them what he knew about the Shaksgam. I remember he came to me at the end of the day and said, "You know it is all very well to fetch me from Calcutta; but the Duke knows it all already." That, I think, is a characteristic of Italian expeditions to which Sir Francis Younghusband has referred: the very careful preparation which leads to ultimate success. Mason told me that His Royal Highness had thoroughly mastered the previous history of the Shaksgam valley and the Karakoram, and was familiar with the names of places, so that it did not take long to pass on any further information.

Well, I think we had no doubt in Simla that the Italian expedition would not climb K_2, but otherwise would be the great success it has been. Our reasons for expecting that the expedition would be successful were twofold. I was in Ladakh not long after the Duke of the Abruzzi and Dr. De Filippi were there, and travelling through the country I was greatly impressed with the memory they had left behind amongst the natives. If you want to travel in the Himalaya, it is no use trying to drive your men: you only drive them away. I think the whole idea of Italian expeditions is that they do carry their men with them. You never hear of any grievances afterwards. And also the arrangements are very complete. I can say that from personal experience. I was going to the Nubra valley with a very light load, and when I arrived at Leh I heard that it was a wonderful place where there were hares, and more vegetation than usual in that part of the Himalaya. I wondered what on earth I was to do for red-currant jelly, and mentioned my difficulty to the Moravian Mission at Leh. They said they had half a dozen tins which the Duke of the Abruzzi had left behind, and that made a great deal of difference to my comfort.

The second reason why we felt the expedition was bound to be successful was the Duke of Spoleto's own personality. The thing that impressed us most was his modesty and his sense of proportion and of humour, which we have seen to-night. I think we all felt that if we were going on a big expedition to the Himalaya, he was the kind of man we would like to follow. Although he seems to be of a very quiet disposition, we felt that if he were up against it he would be not unworthy of that motto which is derived from a poet of his own country, and which has a great history behind it in India: *Mens aequa in arduis.*

It has been a matter of great delight to me, by the kindness of the Council, to have been present this evening to hear the very brief outline that the Duke has given of his expedition. I tried to suggest to him this evening that he should give us something more for the *Himalayan Journal*, but he said we should have to wait for his book, which we would then be able to review. Listening to what he said, there is one thing I should like to call attention to, and that is that we have heard very little of the hardships of travel in the Himalaya. I have no doubt that the expedition went through a great deal more than His Royal Highness gives it credit for, but at the same time I think he has reminded us that exploration in the Himalaya can be a very pleasant thing and can be enjoyed enormously. The hardships are not insuperable, provided one does not try to do too much, though I am not suggesting that the Duke did that! It is good country to travel in and quite a good country to climb in, so long as you do not try to go too high. There are hundreds of fine peaks in the Himalaya that will give all the climbing one could wish for without getting up to the height at which mountain sickness and atmospheric troubles become insufferable to the ordinary person.

There is one other point that struck me very much in what His Royal Highness said, and that is the use the expedition made of skis. In India a year or two ago we

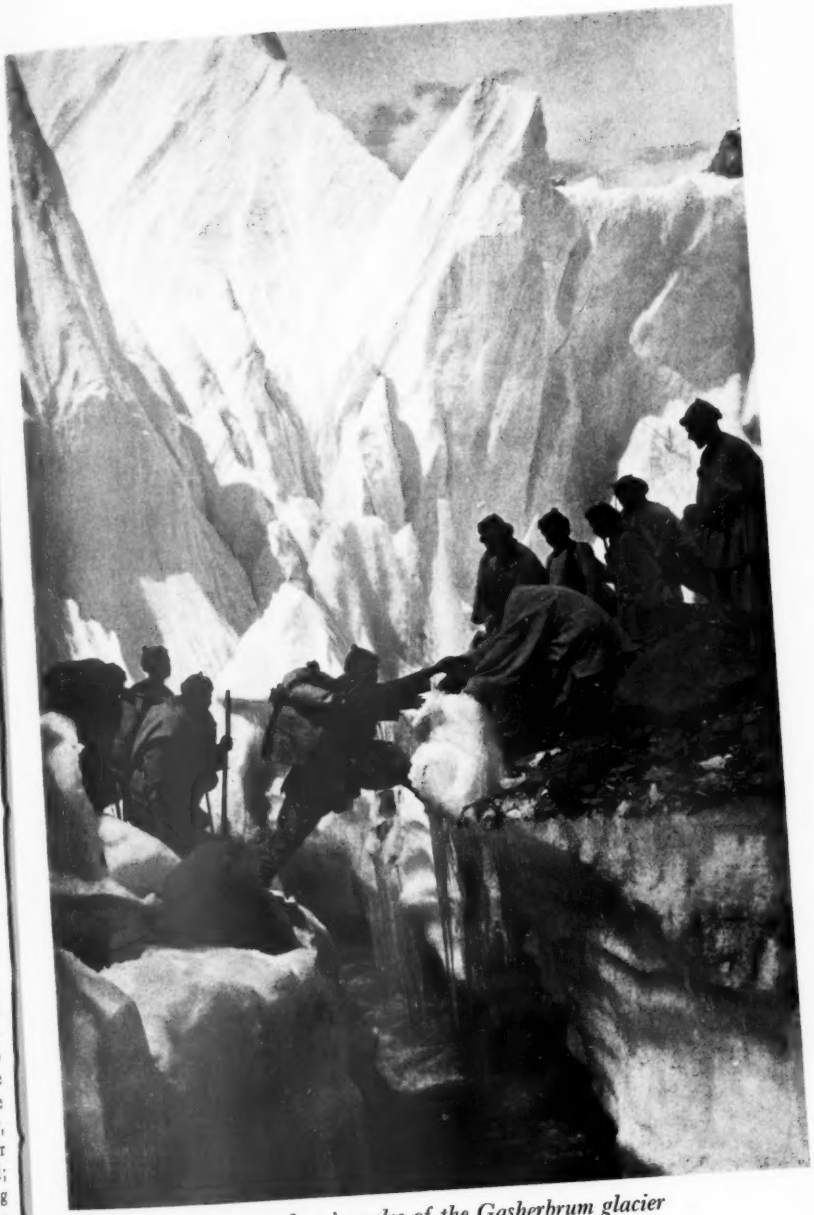
started a Ski Club which is now a very active organization, and which goes up every winter to Gulmarg, where there are winter sports. Although I admit that just sliding down a snow slope does not appeal to me very much, I always have felt that the encouragement of skiing in the Himalaya is going to be of enormous value to Himalayan exploration, because it will enable one to get on the ground quickly and early when there is still heavy snow, as we saw in the picture of the Zoji La, which a month later is merely an ordinary mule track. I hope those going to the Himalaya to explore will bear that in mind and not despise ski-running as an aid to travel in these regions. I appreciate what His Royal Highness has said, and I regard his paper as a first instalment of a very fine book which is coming out later, and of which I hope the Himalayan Club will receive a presentation copy.

General BRUCE: I am very glad indeed to have the opportunity of following Sir Geoffrey Corbett. I was with the Calcutta Club when attempts were being made to form the Himalayan Club, and I believe that Club is now prospering to a degree we should not, two or three years ago, have thought possible, having amalgamated with the Calcutta Club. We are particularly delighted about that, because we hope to back up from the Himalayan Club all further movements for exploration of the Himalaya.

There are one or two points with which I am particularly impressed, and the first is the immense success which all the great Italian expeditions have had with their native help. I know a good deal about this because I have handled Baltis since 1892. The Balti is not a warrior; he is quite a timid little man. With good leading it is possible to do anything with him, but he is not a thruster. He is a great carrier of loads, and if you back him up you can get any amount of work out of him. I know of an expedition which got to Askole and the whole village took to the hillside; no porters were available. This was due to fright from previous treatment. I always feel tremendous admiration for those who go out and get real value from the native help they get. Think of the Vissers; but they were dealing with people who are infinitely finer, far stronger, and more intelligent than the Baltis, and yet think what the Italian expedition have done with their, so to speak, inferior help. You can take it from me that if we had had Baltis on Everest we should have done very little indeed. Yet the Italian expeditions have carried out some of the very finest mountain exploration that has ever been done, by intelligently and sympathetically handling that rather low type, people of low mentality; and they have got them to work cheerfully for them. That is a very great thing. I hope His Royal Highness will allow me to congratulate him on that.

There is one thing in the lecture that I missed. From the Crystal Peak on which, with Sir Martin Conway, I made one of the most delightful climbs I have ever made, we got a view of the Muztagh Tower, in my opinion, the most magnificent mountain that I have ever seen, next to Makalu. His Royal Highness did not show that. It is really a wonderful view.

Something else that was not stressed at all was the very hard work entailed in going up a place such as the Baltoro; even to go from Askole to the Baltoro is rough climbing and rough work. You have to cross a shaky bridge over the Punmah stream. The valley is shockingly hot; a miniature Sahara—no trees, no grass, and the sun pouring down on your back. Then you come to the foot of the glacier. Any one who has seen the Aletsch or the Gorner glacier knows what the end is like, but you cannot compare it to the end of the Baltoro, which is, roughly, 2½ miles across, with a stream coming out nearly as wide as the Zermatt River when it joins the Rhone at Visp. Then you get on to the top, but it is not level; wave upon wave covered with moraine, all loose; up and down you go, slipping the whole time, and you have to do that for three and a half days before you are out of it. Nobody is ever required to do this in the Alps, or thinks of it. Such



Among the pinnacles of the Gasherbrum glacier

The pyramid and saddle of Biacheratu, Nobundi Sobundi valley

work was never mentioned by His Royal Highness, and it really is most tiring going.

In one point that country differs from the other end of the Himalaya to its advantage, namely, the lack of wind. When we were up there we only once got into a really terrible wind, and that was on our way down at the beginning of September, when we were camped on the slopes of Masherbrum; but it was nothing to what is experienced at the other end of the Himalaya. At the same time, you have there far more danger from avalanches, far more danger from great cold, especially if you are there early. We were rather late, and right to the foot of K_2 we could never have used skis. It was absolutely dry when we made our attempt, all the way up to the Golden Throne which is itself the left great boundary on the right of which is the Kondus Saddle aud the Chogolisa Saddle; all the way up were open crevasses and no chance of using skis. They would have been absolutely and entirely out of the question. Nevertheless, if the whole of our route had been covered with snow it would have been very much easier to cross and an advantage to use skis.

Dr. T. G. LONGSTAFF: The account which we have had the great pleasure of listening to to-night finally clears up the fascinating problem set us by Sir Francis Younghusband more than forty years ago. Only twenty years ago one could still write in the *Geographical Journal* that there was no other region of the Himalaya of which we knew less: for the 100 miles between the Muztagh and the Karakoram Pass we knew of no passage across the ranges. Notwithstanding the subsequent work of the Workmans, of Dr. Filippo De Filippi and Major Wood, and of Major Mason's expedition, it has been left to H.R.H. the Duke of Spoleto to complete the solution. Topographically, it is the exploration of the upper Shaksgam valley—the joining up of the farthest points reached by Younghusband and by the late Major Minchinton—that is most interesting. This was accomplished by what we may call "polar methods," or supporting parties; the sending forward of a party to dump provisions, so as to give the exploration party that necessary margin of "food-days," in order that lack of food should not force them to return with their work uncompleted, which, as a matter of fact, others had to do. The Italians have successfully achieved what their predecessors were unable to accomplish. I hope we shall learn the lesson to be derived from their thoroughly deserved success.

Then there is the exploration of both sides of the Sarpo Laggo pass. From the photographs we have seen it appears to me as if they have shown us a better route across the main chain than the difficult Muztagh Pass. They have also cleared up the topography of the head of the Punmah glacier system—a very fine piece of work. The topography of that region has puzzled geographers ever since Sir Martin Conway drew attention to it last century. Apropos of that I would plead very strongly for the acceptance of His Royal Highness' suggestion that the name "Conway Saddle" should be given to the saddle on which the Duke camped at 20,000 feet at the head of the Baltoro, which probably looks down on to the Kondus, because Conway's was the first of many "Alpinist" expeditions which went to this very difficult region of the Karakoram. Our prejudice against giving personal names to peaks in the Himalaya is, I know, very great, but the real point is that the Duke went to that point because of the real topographical importance of it, and it was the point that Conway, so to speak, laid his finger on. Though Conway did not reach it he pointed out the importance of that spot. The Duke is the first man to get there, and he suggests, very generously, that Conway's name should be attached to it. In my view the historical arguments for using Conway's name in that connection are very great, and though I know that the Royal Geographical Society and the Survey of India object to personal names, I

still hope that His Royal Highness' suggestion will meet with the support of the Society.

Further, I wish to take this opportunity of making myself still more unpopular with the orthodox. I want to press most strongly for the retention of the name "Younghusband's Saddle," which I put on my map of 1909, for the uncrossed pass at the head of the Urdok glacier. This name has priority over "Indira Col," subsequently bestowed by the Workmans. Of course I only saw it from the south. The Duke's expedition has at last proved that the position I gave for it was correct. Now that after forty years the problem set by Younghusband has been solved, let the map hold the name Younghusband's Saddle. That name is the historical key to the exploration of this region, and should be preserved.

Sir Francis Younghusband, you will remember, came from the north. He was on other business of some importance, but he diverged to come through the Aghils and look for the reputed "Saltoro" pass that led through the 100-mile uncrossed section of the Karakoram, and went up a glacier which he called the Urdok glacier. When I came to make my map, which was a sketchy one, I fortunately got the position of that saddle at the head of the Urdok glacier pretty well correct; Colonel Balestreri, Professor Desio, and Signor Ponti have proved that what the Workmans afterwards christened the "Indira Col" is "Younghusband's Saddle " of my map. The name Indira Col is derived from Sanskrit and French; nothing could be more out of place in a country where only Balti or Turki is spoken. There are no native names in this region because there never were any inhabitants. Even so old and experienced a traveller as Sir Francis Younghusband has to name a glacier after a dead bird he found upon it. I therefore invoke the law of priority of nomenclature also, for the retention of the name Younghusband's Saddle, as recorded in the Society's *Journal* twenty years ago.

It is getting late. I am not here to pay compliments; but we must all realize, and experienced travellers in this audience do realize, that the success of the Italian expedition is due to the leadership displayed. The organization and the handling of so large a party; the complete success in the accomplishment of a large and complicated programme; the reticence of the lecturer as to his own part in the expedition; his care for his coolies and the avoidance of any accidents or unnecessary hardship to them—all these evoke our admiration. I beg to congratulate your Royal Highness on an achievement which I am confident will ever remain most remarkable in the annals of Himalayan exploration.

[I would like to add the following note: When I reached the middle Siachen glacier in 1909 I saw a depression at its head which I marked on my sketch-map (*G.J.*, 35, 744) as Younghusband's Saddle, placing the Urdok glacier on the far side. I think this is confirmed by the Italian explorations from the Shaksgam side. On the Workmans' map (*G.J.*, 43, 232) they rechristened this the Indira Col, and their photograph opposite p. 128 is given as a view of the Gasherbrum glacier from the Indira Col. I think it is clear now that this photograph shows the Urdok Glacier and not the Gasherbrum glacier. They drew the Urdok glacier farther east, articulating with their Turkestan La, which I think must really articulate with the Stagar glacier of the Italian expedition. It is clear that I could not have seen their Turkestan La from my station on the middle Siachen, so there can be no confusion.

I would also take this occasion to urge that the name Saltoro Pass, bestowed by Vigne in 1835, and used on Younghusband's map, ought to be preserved for the pass since called the Bilaphond La (*vide G.J.*, 35, 622, and *G.J.*, 43, 144).—T.G.L.]

The PRESIDENT: I am sure you would wish me in the name of the Society to send a telegram to-morrow to General Vacchelli thanking him for the kind message

which His Royal Highness read to us before commencing his lecture. Secondly, I have to announce that Sir Martin Conway intended to be present but was forbidden by his doctor. Thirdly, I should like to mention that K_2, as far as we know, really is the second highest mountain in the World. Although you will see it stated, in this week's *Illustrated London News*, that Kangchenjunga is the second highest, this is probably not the case; most geographers who have studied the question would say that, although there is some uncertainty, K_2 is the second highest.

We are all very grateful to the Committee which assembled at Milan, to the Italian Royal Geographical Society, to the Milanese section of the Italian Alpine Club, and to His Royal Highness for organizing the expedition. We congratulate His Royal Highness on the thoroughly scientific organization of it. The expedition carried out not only exploration and survey but magnetic and gravity observations; it did geological work, as we know from Professor Desio's remarks; it made careful surveys; it did scientific work in zoology, botany and anthropology. Another fact on which we congratulate the expedition is the use of skis, triumphant use, one might say, in the Karakoram, probably for the first time, certainly for the first time on an extensive scale. And last, but not least, we congratulate the expedition and His Royal Highness on his use of the Wild phototheodolite, from which we expect the most happy results.

As regards the Conway Saddle, I am not, personally, a purist in these matters. I think we shall lose a certain amount of history if we do not attach to features in the Karakoram some of the names connected with the exploration of the region. It would be a good thing for those who follow us 2000 years hence to find a few English names on the maps. Supposing our Anglo-Saxon ancestors had not put a few personal Saxon names about England! We need not overdo it, but I think I can promise that the Council of the Royal Geographical Society will consider sympathetically His Royal Highness' kind suggestion.

It remains for me only to congratulate His Royal Highness on the success of the expedition and to thank him very heartily for the admirable lecture to which we have listened.

GEOLOGICAL WORK OF THE ITALIAN EXPEDITION TO THE KARAKORAM: *A paper read at the Additional Afternoon Meeting of the Society on 25 February 1930, by*

PROFESSOR ARDITO DESIO

THE geological observations that I carried out during the expedition of H.R.H. the Duke of Spoleto to the Karakoram embraced both slopes of that great chain, with special reference to the basins of Baltoro, Punmah, Sarpo Laggo, and Shaksgam.

I shall only be able here to give a summary account of the main results obtained in the field of the stratigraphical geology, tectonics, and geomorphology of the region. As the paleontological material collected has not yet been completely classified by me, and as the lithological collection is still under examination by one of my assistants, this must necessarily be considered as a preliminary report only. The data to which I will refer are really only a summary of my travelling notes.

The information we obtained beforehand about the country that we have explored was very meagre indeed concerning the southern zone (Punmah and Baltoro), and on the northern we found no information whatever. Moreover, what little was known could be traced only to laboratory observations on collections made by casual travellers, not by geologists. One such collection was brought home by Mr. Conway and studied by Bonney and Raisin ; * another was made by the Expedition of H.R.H. the Duke of Abruzzi and had been illustrated by Novarese.† Up to date no fossil was known to have been traced in Baltistan. More information was available as to the morphology of the zone, specially of the Baltoro, because all the preceding expeditions had furnished reports on this subject.

As to the cartography of the region, I had the opportunity of tracing hurried sketches of the territory along the beaten tracks on my trip across Baltistan, and more accurate maps of the basins of Baltoro and Punmah. Of course they are only as accurate as circumstances would allow in a country of inaccessible mountains and very extensive glaciers. The geological sketches were drafted partly on direct observation of the rocks, partly by the examination of morainic material, and finally by diligent inspection at a distance.

The basin of Baltoro is eroded nearly up to the Concordia amphitheatre, in a powerful series of biotitic gneiss, crossed in all directions by numerous wide dykes of granite and pegmatitic granite. All the north slope of the Masherbrum-Bride chain up to the Chogolisa saddle is composed of such rocks, with the exception of a narrow strip of foliated micaceous gneiss and shales which outcrops on the northern side of the Bride and Mitre.

The side of the Baltoro valley which is formed by the southern slope of the axial range of the Karakoram, is also formed of gneiss and granite up to the

*"Notes on Mr. W. M. Conway's collection of rock specimens from the Karakoram Himalayas." Scientific Reports in W. M. Conway, 'Climbing and Exploration in the Karakoram Himalayas.' London, 1894.

†"Appunti geologici intorno alla Spedizione di S.A.R. il Duca degli Abbruzzi nel Karakoram." In De Filippi, F., 'La Spedizione nel Karakoram.' Bologna, 1912.

Muztagh Tower, while farther east the foliated gneiss make their appearance in association with shales and crystalline limestone. The outcrop of the former rocks describes a bow with the convexity towards the south-west, and in the inner side the limestone is found, rising up to form the Crystal Group.

Towards the east the limestone spreads out and rises to form the gigantic tops of Broad and Gasherbrum. On the southern and western slopes of these mountains the shales make their appearance and they go on growing in extension northwards, in the basin of the Godwin Austen Glacier. The isolated mountain between the Savoia Glacier and the Crystal Peak is also formed of shales.

The commanding pyramid of K_2 is composed of well-stratified banks of gneiss, occasionally foliated, the same as on the southern slope between the De Filippi and Savoia glaciers. Granite dykes cross-cut the mass of gneiss. Also the snow-clad top of the colossal mountain must be of clear gneiss, a hypothesis that I found upon the appearance of the rocks (in place) and upon the nature of the detritus carried down by the glaciers. More complex is the case of the Broad. On the eastern side we find limestone (non-crystalline) which extends nearly to the top, but in the hills on the northern side the shales are also in evidence, beside gneiss, granite, amphibolic-diorite with serpentine and green rocks of the prasinitic type, which cut into the limestone masses of the Baltoro.

The most northern outcrop of limestone is that which forms the ridge between the Vittorio Sella pass and the Broad, a narrow strip of microcrystalline limestone of a white and grey colour. South of Broad the limestone series extends over the Gasherbrum group. The enormous group of mountains is almost entirely composed of grey and black limestone, occasionally assuming a schistose character and bearing fossils. Among the debris carried by the glaciers which descend from the southern side, I observed and collected a certain number of fossils, especially lamellibrancs, gasteropods, and corals intensely laminated, in association with foraminifera (*Neoschwagerina*) of the Permo-Carboniferous age.

We have still to make reference to the Golden Throne region, between the ice-stream flowing down from the Chogolisa Saddle and the branch that leads to Conway's "Probable Saddle." In this zone, amid the vast snow cover, outcrop polichromous limestones, yellow, green, and red sand and calcareous schists, brecciated red, white, and grey limestones. Occasionally these rocks present a sub-crystalline facies. According to observations at a certain distance from Conway's "Probable Saddle," the limestone masses extend eastwards, on the other side of the Baltoro watershed.

The Punmah basin, which lies more towards the east, is mostly cut out in gneisses and granites: such rocks form all the eastern watershed to the head of the Drenmang, the chain that divides the branch of the Dumulter from that of Choktoi, and the other chain that separates the latter from the Nobundi Sobundi. The prominent peaks of the Skamri range, which rise at the head of the principal valley and belong to the ridge of the Karakoram watershed, are on the other hand composed of a powerful sequence of white and grey crystalline limestones, with an inter-bedding of shale belts towards the south. This outcrop occupies all the right side of Dremang valley and the left side of the

Nobundi Sobundi valley, but disappears within a few miles of the mouth of the valley. On the hillside the limestone curves towards the north and passes to the other slope of the range. Particular interest is attached to the discovery of *Fenestellae* in the black shales of high Punmah, which I venture to attribute to the Carboniferous formation, also owing to their perfect resemblance to the *Fenestellae* shales of Kashmir.

Let us now pass to the northern slope of the Karakoram. The high valley of Sarpo Laggo is mostly composed of gneisses and granites quite similar to the types already mentioned. In association with them we find shales which reach their greatest development towards the lower and middle section of the glacier. In the former section gneisses and granites alternate with green schists, similar to the Shigar shales, and all the features recall those of the region between Baltoro and Biaho. Towards the end of the Sarpo Laggo glacier, the limestone series is met again, composed of grey limestone, clay limestone with a bluish tinge and fossil-bearing, and red shales and polychromous conglomerates. This series corresponds to that of the Golden Throne, slightly metamorphosed.

The limestone sequence extends in the lower Sarpo Laggo valley, consisting here of grey limestone and black calcareous shales, separated from the preceding sequence by an outcrop of gneiss and granite which descends from the great valley of K_2. In the region where the valleys of Sarpo Laggo and Shaksgam come together, we find formations answering to the normal facies. They are mostly grey and black limestones, often bearing silex and more or less abundant in fossils, including corals, black, red, and violet calcareous shales, brown sandstones, and polychromous conglomerates. In other places whitish quartzites are met and greenstone dykes.

This formation, which can be followed all along the Shaksgam valley, is frequently rich in fossils. A great many collected by me allowed me to ascertain their age as Permo-Carboniferous revealed by the presence of *Fusulina*, *Polipora*, numerous *Productus*, including *Productus punctatus*, and *P. pustulosus*, *Dielasma*, *Reticularia*, including *R. lineata*. The specimens collected were quite numerous, but unfortunately one of the cases containing them went astray during our return trip across Baltistan. The greatest number of specimens were taken in the Sarpo Laggo basin, in the middle Shaksgam valley, and in the Urdok basin. Nevertheless on my return trip I was able to collect a few from this region, which were packed in another case which reached home safely. Above this series lay a dolomitic limestone of light grey colour, in which I noticed the presence of sections of large shells which most probably, on account of their facies and of their stratigraphical position, belong to the Trias.

As to the formation of the region south of Shaksgam, I was able to collect a few data climbing up the Urdok glacier and taking in account the debris from the various glaciers. The northern slope of K_2 must be mainly composed of *augen*-gneiss and of biotitic-granite, because these rocks compose exclusively the moraine coming down from the great valley of K_2, towards the Sarpo Laggo valley. The shales and a few pebbles of red crystalline limestone which can be found in the moraine, seem to be derived from the northern divide. The northern slope of the high ridge, which extends from Windy Gap to the Indira Col, is composed mostly of limestone entirely similar to that of the Golden Throne. But along the western side of the slope the gneisses and the granites

must necessarily pass also to the northern slope, because these rocks make their appearance in the moraine of the Gasherbrum and Windy Gap glaciers.

To the east of the Indira Col the main ridge of the Karakoram is also formed of sedimentaty rocks with normal facies. Of this the moraines of the Stagar, Singye, and Kyagar glaciers bear evidence, carrying slate freely and being entirely lacking in gneiss and granites.

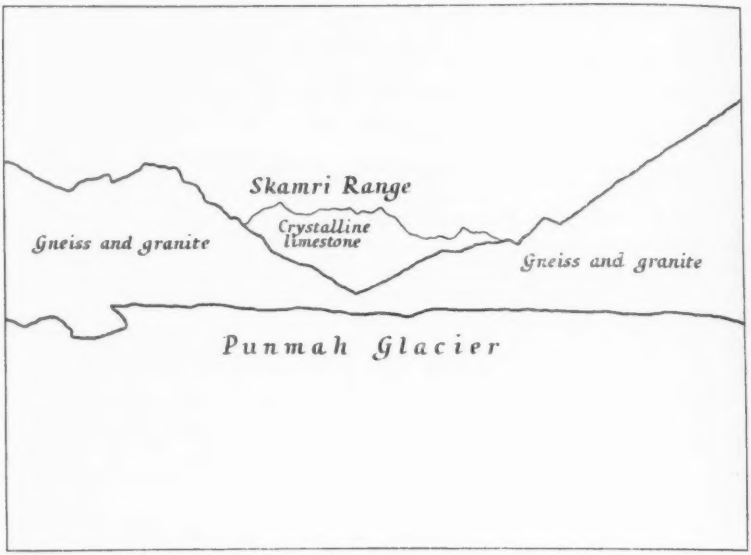
Having thus touched on the main geological regions of the explored country, it may be advisable to refer to the stratigraphical series. The basis of the series is constantly formed of light grey gneiss, nearly always biotitic, occasionally pseudoporphiric, and *augen*-shaped, crossed in all directions by granite dykes which occasionally assume imposing proportions. In the higher levels the black mica content of the gneisses increases, giving them a greater schistosity and a darker tinge. Higher up and next to these occur very thick shales, and farther on crystalline limestones interbedded with shales, amphibolic-serpentine, schists, mica-schists, and plyllites. This sequence, on the lower horizon, is crossed by granite veins. Where the action of metamorphism has been less pronounced, we found a few fossils, as for instance in the high Punmah. I see a correspondence between this series, at least in its lower level, and that of normal facies of the Shaksgam valley, of the Golden Throne, and of the Gasherbrum-Broad ridge, of Paleo-Mesozoic age.

I shall be unable to advance accurate information as to the tectonics of the region until the topographical maps are in order, because only with their assistance shall I be in a position to plot down in their place the collected data and thus recognize their relation to one another. On the other hand, a synthesis on the geology of the Karakoram Range would be for the time being somewhat premature. I will, therefore, here report only a few summary data.

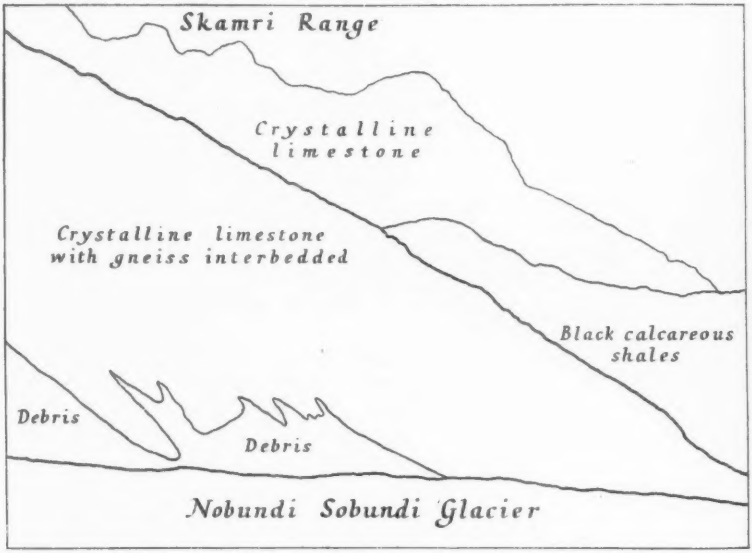
The general trend of the folds of the Karakoram in the region included between 75° 30′ and 77° 30′ E. long. is fairly uniform and directed N.W.–S.E. From the Punmah basin, where this direction prevails, the outcrops show a tendency to assume an east–west trend as they approach the high tributaries of the Baltoro glacier: here they describe a slight curve, after which towards the east they once more assume their original direction.

The granite-gneiss principal nucleus, which measures at the surface about 20 km., runs south-east from the watershed ridge between Nobundi Sobundi and Choktoi, with Biaho (going through the principal valley of the Baltoro) in the direction of the Masherbrum-Bride ridge, from which it extends beyond the stretch of country under consideration. The scanty information at our disposal about the south-east country (the basins of Kondus and Siachen) may allow us to think that this nucleus continues in the same direction, towards the Siachen basin and the low Nubra valley.

A secondary nucleus, which has a shorter outcrop, runs to the north-east of the former one and embraces the K_2 group, remaining nearly completely buried under the limestone cover to the west of the Godwin Austen glacier. The calcareous region of Skamri in the Punmah basin lies between these nuclei. Towards the north and south the two nuclei run in between two calcareous-schistose zones, one with normal, the other with metamorphic facies. The latter runs across our region between Askole and the Biaho valley, the former follows the middle and high valley of Shaksgam. Lack of geological records



prevents us from following these zones towards the east and west with any degree of accuracy; but, according to information gathered from the petrographical examination of the specimens collected by various expeditions which have prospected the basins of Biaho, Hispar, and the district of Hunza and



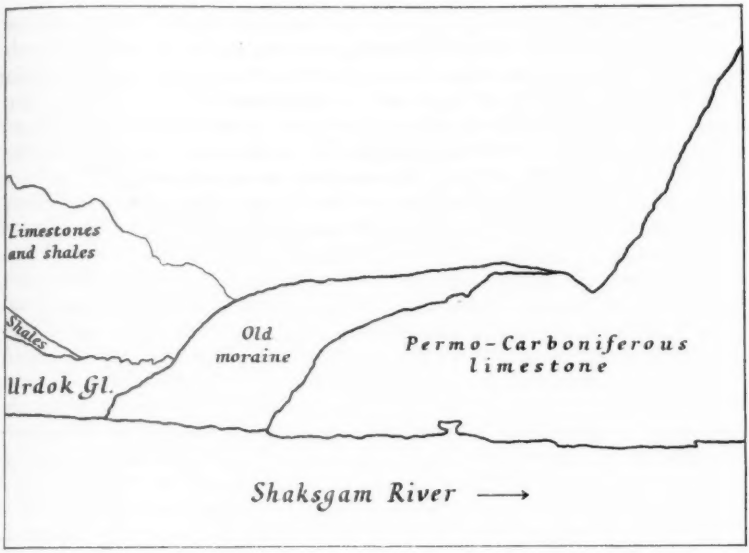
The Skamri range and Punmah glacier

Geology indicated on opposite page

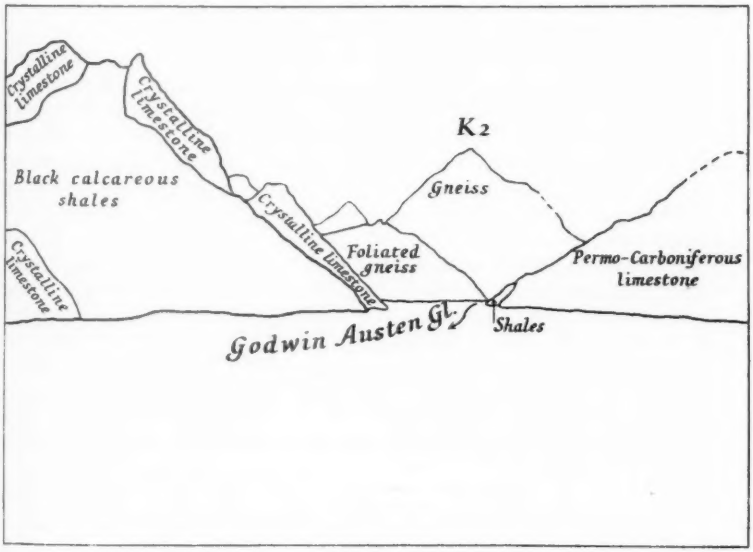
The Skamri range and Nobundi Sobundi glacier

Isolated rock in front of snout of Urdok glacier, Shaksgam valley

K2 and Godwin Austen glacier from Concordia (Baltoro)



Nagar, the extension towards the north-west of the very same formation that we have studied in our region may be considered as likely. The principal granite-gneiss zone extends towards the high Biaho, the Hispar, and the Hunza; more to the north a calcareous-schist zone makes its appearance, following in a general



way the Shingshal valley and the Batura glacier. An indication of the crystalline nucleus of K_2 may be represented by the granite-dioritic outcrops of the Gujirab valley, while more to the north limestones and shales appear. Farther on again we find the granites in the high valley of Barakhum. Certain evidence of the continuity of the zones in this strike is also forthcoming from the observation of the general direction of the strata, a direction which varies from N.W.–S.E. to W.–E., and which coincides with that found by me more to the east.*

Following our zones eastward we see that the crystalline nucleus extends to the south-east in the direction of the Siachen basin. It seems that the calcareous zone of Gasherbrum, with a more schistose texture, crosses the same basin with a slight curve in the outcrop from south-east to east. I cannot advance any statement as to the continuity of the crystalline nucleus of K_2, while it appears that the paleozoic-mesozoic zone points towards the Karakoram Pass. From the old geological map of Lyddeker,† it would appear that the synclinal zone of Gasherbrum ought to join with the syncline of the Chang Chenmo valley in Ladakh, but recent observations on the east Karakoram Range do not agree with the data furnished by this map. Therefore the position to-day is that the meagre geological observations at our disposal hinder us in an accurate interpretation of the present morphology of the country.

Considering only the region that we have examined, we cannot trace a genetic connection between its tectonics and its morphology, because in connection with sinclinals we do not find depressions, nor high ground corresponding to anticlines. Let us recall as an evident proof to this effect that the groups of Broad and the Gasherbrums and the Skamri range are found in a synclinal zone.

On the other hand, it is fairly easy to recognize a remarkable coincidence between the morphology and the lithological composition of the ground. Thus we find in correspondence to soft schists the occurrence of erosion features, such as valleys, saddles, etc., while in connection with hard rocks we find high ground. I may quote as examples the Shaksgam valley just above the Aghil Dawan gulch, cut mostly in the shales interbedded between limestone; the valleys of the Urdok, Stagar, and Singye rather similar; the high Baltoro valley corresponding to a schistose belt, close in between the Gasherbrum limestones and the granite-gneiss of Bride; and the valleys of the Nobundi Sobundi and Drenmang in a similar position. Referring to the high ground, we notice that all the tops of the ridges are composed of crystalline rocks or of very compact limestones.

But numerous valleys, including some of the principal ones, do not show such a correspondence, inasmuch as some of them assume the very same direction as the folds, while other transverse valleys show a completely independent character. Among the last I note the Dumordo–Punmah valley, and part of the Sarpo Laggo valley; among the former the valley of the Baltoro, Choktoi, and Dumulter, and the Shaksgam Valley above the Sarpo Laggo junction.

In these instances the origin of the valleys appears to be quite obscure, if we

*Kuenen, Ph. H., "Petrographic description of rock from the Hunza valley in the Karakoram," *Leidsce Geologische Mededeelingen*, III, 1, 1929. Leiden.

†Lydekker, "The Geology of the Kashmir and Chamba territories and the British District of Khagan," *Mem. Geol. Survey of India*, vol. xxii. Calcutta, 1883.

wish to consider the geolithological constitution without taking into due account the initial topographical surface, on which the primitive drainage system was developed, and of which the present feature of the ground is only a consequence. At the present stage of our knowledge the reconstruction of the original surface of the country is quite out of the question. Nevertheless a rough idea of it may be obtained by supposing all the valleys to be filled up with the debris carried by the agents of erosion, and the tops of the hills that the meteorological agents have in recent times broken and sharpened, rounded. We would then obtain an undulating country with summits corresponding to the central range of the Karakoram and sloping down with a certain irregularity north and southward: a sort of undulating highland in which we would find inlaid, as in mosaic work, the upper plateau of Tibet and Kashmir, and minor tracks of uplands that can actually be found on the Aghil Range. On this imaginary surface the trend of the valleys under discussion only seems to fit indifferently. Therefore, if in a few cases it may be considered as the last remnant of the consequent drainage system, in general we miss a sure and evident connection. This suggests the conclusion that the original topographical surface of the country has not only been deeply cut by erosion, but also remarkably distorted by endogenous forces. But if it may be allowed tentatively to suggest some possible solution to the geomorphologic problem of the region, we cannot, at the present stage, proceed any further without stepping into fancy speculations.

From the far-off ages in which we suppose that the drainage system originated, many facts have evolved and new morphogenetic agents have made their appearance. The present morphology manifests a great prevalence of young forms which lead us to the conclusion that the uplift and folding of the region have not ceased. These are young forms which, though worn by the glaciers, still show a fluvial origin, at least considering the enormous depth of the present valleys, lying thousands of metres below the remnants of the oldest topographical surface of the region, which could not be accounted for only by the theory of the active erosive effect of the glaciers. Also in the Karakoram the glaciers have limited their action in correcting and adapting to their particular requirements the fundamental lines of the features that other agents before them have established.

The glaciers we see at the present time, of the Alpine type, though some of them are amongst the largest in the world, are only the remnants of more powerful ice-streams filling all the valleys of the country during the Ice Age. In the Shigar and Braldo valleys we see two evident systems of old lateral moraines; the highest runs 300–400 m. above the present bottom of the valley and continues towards the Skardu basin. Higher up the valley the moraines go gradually up and connect with the old moraines of the Baltoro basin, between Urdokas and the front of the glacier. The morainic band bordering the great ice-streams during the Pleistocene Age suggests that during the Ice Age the Punmah as well as the Biafo glacier were right-bank tributaries of the great Baltoro glacier, numerous other smaller glaciers flowing down the sides of the valley.

We observe also in the Shaksgam valley old moraines lying 300 m. above the bottom, near the junction of the Sarpo Laggo with the Shaksgam rivers.

The morainic material extends upward in the Sarpo Laggo, Gasherbrum, Urdok, Stagar, Singye, and Kyagar valleys. We can consequently conclude that during the Ice Age large glaciers flowed together in the Shaksgam valley and formed a direct ice-stream towards Yarkand.

Among other signs of the Ice Age we must not forget the *roches moutonnées* and the scratched rocks, everywhere scattered about on the slopes up to conspicuous heights. We also find remnants of more recent ice stages, such as morainic amphitheatres that side glaciers constructed mostly at the bottom of the main valleys, as, for instance, near the Shimtsa Jangal in the Dumordo valley, not far from the front of the Punmah glacier.

All these facts concern rather old movements of the fronts of the glaciers, but we also have proofs of quite recent movements, small though they may be. Before the prominent side of the Baltoro front, Prof. Dainelli,* during the winter 1913, observed a huge morainic block about 80 m. from the end of the ice. In May 1929 I found the same block in contact with the ice. During the last fifteen years the front of the Baltoro glacier has advanced about 80 m., and at the present time it appears so much swollen as to suggest that it may be increasing.

Quite different are the conditions of the front of the Biafo glacier where, 80–100 m. from the ice, there are short morainic heaps. If we compare Dainelli's observations made in the winter of 1913, when the minimum of the distance between the front and the left side of the Biafo valley was about 40 m., with the conditions found by me in May 1929, when the distance was about 180 m., we may conclude that during the last fifteen years the front of the Biafo glacier has retired more than 100 m. But it seems that the retreating movement has not been continuous, because Featherstone in 1922† observed that the glacier was advancing. The information about the Punmah glacier is more meagre and uncertain. Godwin-Austen‡ in 1861 found the glacier retreating, observing that the camping-ground of Punmah was at that time buried by the ice. At the present time it is uncovered again, but the glacier end is very swollen, and other symptoms seem to indicate that the glacier is rising.

I have scanty information about the glaciers of the north side of the Karakoram Range. The most interesting fact is that Sir Francis Younghusband,§ in the year 1889, travelled round the front of the Gasherbrum glacier along a gorge open between the ice and the cliff of the valley side, while in the June of 1929 the glacier pushed its front, bristling with ice-pinnacles, against this cliff, and the Shaksgam river was obliged to flow below the ice. But we possess no information about the movement during the last forty years of the front of the Gasherbrum glacier, now extending farther in the valley, as in 1889. We have lost, also, previous data on the glaciers crossing the Shaksgam valley higher up. The two highest, the Singye and Kyagar glaciers, push their fronts up to the cliff on the right side of the valley; whilst in front of the Urdok and the Stagar

*Dainelli, G., "Le condizioni fisiche attuali," Vol. iv, Ser. ii, of 'Relazione scientifiche della Spedizione Italiana De Filippi nell' Himalàia, Caracorùm e Turchestan cinese, 1913–1914.' Bologna, 1928.

†Featherstone, B. K., "The Biafo Glacier," *Geogr. Journ.*, LXII. London, 1926.

‡Godwin-Austen, H. H., "On the glacier of the Mustagh Range," *Journ. Roy. Geogr. Soc.*, London, 1864.

§Younghusband, F. E., 'The heart of a continent.' London, 1896.

Jangal in the Sarpo Laggo valley

Highly inclined ice strata in isolated pinnacles of the Gasherbrum glacier

The front of the Gasherbrum glacier

Dolomite peaks along the Shaksgam valley

glaciers there is a fairly broad gorge. Judging by appearances, it seems that the former are rising and the latter retreating. The conditions of the Kyagar glacier were just the same in 1929 as they were when observed in 1926.*

The last variations affecting the fronts of the Kyagar and Singye glaciers were apparently not very remarkable. The lacustrine terraces above the Kyagar testify that the damming of the Kyagar lake by the glacier may not be of recent date. We observe the same facts above the Singye glacier, where there are sand-beds and remains of terraces testifying the existence of an old lake dammed by the glacier. About the Urdok and Stagar, we observed that beyond the fronts of the glaciers isolated rocks covered by morainic gravels and moraines up to the right bank of the Shaksgam river testify that these glaciers also barred the valley. It seems, however, that at the same time two glaciers—one flowing down the Windy Gap near the Gasherbrum glacier, the other lying between the Urdok and the Stagar glaciers—heaped up two characteristic morainic amphitheatres, some 100 metres from the present front, and that other front moraines observed by me not far from the end of some slope-glaciers, were accumulated at the same time.

I examined some problems connected with the morphology of the glacier surface during the expedition, and one of the most interesting is that of the origin of the ice-needles with which the surface of some glaciers, especially those in the Shaksgam Valley, are filled. If the phenomenon had already been noticed on certain glaciers of the southern portion of the chain, it was certainly not to be compared with the forest of ice-needles of the Singye and Kyagar glaciers (the ice-needles on the latter have already been described by Mason), in which the pinnacles of ice rise to 60–70 m. and almost entirely cover the main ice streams. I will not now refer to the various explanations of this strange phenomenon, but I will only touch on the results of my personal study.

In examining carefully the structure of the ice-needles it is noticed that in every case they are formed from white stratified ice, and the strata are more or less upright. Of these strata, some appear to be made of thick crystalline ice, and others of ice less thick and granular. I think that the development of the ice-needles might be attributed to the minor fusibility of the thicker strata and the intense rays of the sun. It is unnecessary for me to enlarge too fully upon the reasons (considering always composed glaciers) for the strata being upright below a certain height. But if this fact will help to explain the longitudinal decomposition of the glacier surface, some explanation is needed on the transverse decomposition, which is also due to the same causes. It is noticed that in the terminal part of the glacier the strata form a table-spoon curve, or rather that the tops of the ice-strata rise up towards the sky in all directions and therefore transversally also to the glacier. Where the fronts of the glaciers encounter an obstacle this vertical tilting of the strata is stronger, and so we should find a greater development of needles. In fact, in the Kyagar and Singye glaciers, and on a minor scale in the Gasherbrum glacier, whose fronts abut on a rocky wall; the phenomenon of the needles is much more developed than elsewhere.

At the same time higher up, yet always in the melting zone, we find some needles, but always lower and more aligned in the longitudinal sense the nearer they are to the upper limit of the melting zone.

*Mason, K., 'Exploration of the Shaksgam Valley and Aghil Ranges, 1926.' 1928.

THE SEINGHKU AND DELEI VALLEYS, NORTH-EAST FRONTIER OF INDIA: *A paper read at the Evening Meeting of the Society on 10 March 1930, by*

F. KINGDON WARD

IN 1926 and 1928 I made two expeditions into the mountain region in the extreme north-east corner of the Indian Empire, the second being the lineal descendant of the first. The object was to break through the middle of that belt of lofty peaks which stretches in a general east-and-west direction from Sikkim to Yunnan. This region has been botanically explored from either end: from the west through Sikkim and Bhutan, from the east through Yunnan and Szechwan as far west as the Salween valley. But of the mountain flora between the Salween and the Dihang practically nothing was known in detail, although of course the prevailing type of plant association was known. This difficult country might be more easily explored from the north; but so long as Tibet remains exclusive, that is impossible for the scientific traveller. The alternative was to penetrate it from the south.

These two expeditions—the Seinghku valley (Burma) expedition of 1926, and the Mishmi Hills (Assam) expedition of 1928—were financed by the trustees of the Percy Sladen Memorial Fund, the Government Grant Committee of the Royal Society, and by a small group of amateur horticulturists under the chairmanship of Mr. Lionel de Rothschild. On the second expedition in 1928 I was accompanied by Mr. H. M. Clutterbuck, who had previously been on two of the Oxford University Spitsbergen expeditions.

THE SEINGHKU VALLEY EXPEDITION, 1926

I left Myitkyina at the end of March, and following the Mali valley mule road, reached Fort Hertz (214 miles) on April 14. From Fort Hertz the path continues north-eastwards over the hill ranges dividing the two main branches of the Irrawaddy, as far as the Nam Tamai. Owing to the lateness of the season, however, the muleteers refused to go any farther; nor is it likely that, had it been earlier, they would have consented to go beyond Fort Hertz. The Panthays greatly dislike the hill jungle east of the plain, where the path is not so good, and it is difficult to get food for man or beast. Transport throughout this country is indeed one of the major problems. The scanty population is least occupied in earning its daily bread in the height of the summer and in the depth of winter, neither of which periods is the most convenient for the botanist to travel in the jungle.

However the territory is administered, and, thanks to the Assistant Political Officer, cooiie transport was arranged for me from Fort Hertz to the Nam Tamai (nine marches), and a further six marches up that river to the Seinghku confluence; and this with so little delay that, although needing fifty-five coolies to carry kit and rations for myself and servants for four months, we reached the confluence on May 8.

The country through which we had passed so far is explored and surveyed, though hardly well known outside a limited circle. As however I gave a

general description of it in a paper published in the *Geographical Journal* in 1923,* I have little to add here.

Since leaving the Shan plain of Hkamti Long we had passed through the last of the Kachin Hills, and now found ourselves amongst the Nung (or Khanung) tribe. The mountains do not exceed 8000–9000 feet, and are covered with dense forests of Indo-Malayan trees. The valley of the Nam Tamai, however, is more thickly populated than many other parts. Cultivation is carried on up to about 5000 feet, and there are villages of ten or twelve huts. Unfortunately there had been a serious famine the previous year, due to the flowering of certain bamboos over a wide area. This had provided such an unexpected store of food for the jungle rats that they had greatly increased in numbers. When the bamboo seeds were finished, the rats had overrun the villages and cleared off most of the grain with disastrous results for the wretched inhabitants, who in the best seasons have no surplus. When famine comes the tribes know only one remedy: they migrate from their villages, which are left entirely derelict, and camp in the jungle, where they search for roots and berries to live on, chiefly the big tubers of species of Dioscorea, which luckily are not rare. It is a remarkable fact that these forests, so extensive and so varied, should be so poor in food products. There are of course the wild "yams" just referred to, a few sago palms (mostly cultivated but apparently indigenous), wild bananas, and species of Garcinia, in the subtropical forests. In the intermediate zone there are raspberries and various toadstools; the seeds of bamboos are also eaten. Finally, in the alpine zone the bulbs of Fritillaria are dug up and eaten, and the leaves of certain plants are used like spinach. When times are good the Khanungs live on grain and fish, besides almost any creature they can shoot with the crossbow, or trap, including monkeys, birds, lizards, frogs, and mice; they also eat bugs. But although the supply of food is meagre, the jungle supplies the Nungs with many other wants, including all the material for building their huts, some clothing, spices, dyes, and so forth.

In the track of the famine we came across many fresh graves. Over each was hung the property of the deceased—a hat, a bag, a pipe or cooking-pot—and a collection of graves would be marked by several crudely carved birds with outspread wings perched on poles. These represented the souls of the departed flying away towards the rising sun—a pretty idea one would scarcely associate with these poor folk. But the Nungs are an unusually simple and gentle tribe.

We were kept waiting a week at the confluence, where the Seinghku and Adung rivers unite to form the Tamai; but during that period I was gradually getting the loads moved a day's journey up the Seinghku. This river is spanned by a rickety cane bridge just above the confluence, and we camped in the angle between the two noisy rivers. Although the altitude is only 4000 feet, I found the first Rhododendron† here, a white-flowered epiphytic species, perched high up in the tree-tops. While we were here, two Chinese pedlars, who had been selling salt and cloth up the valley, passed on their way back to China. One had two coolies to carry his goods, the other four. These men come from as far away as Weihsi on the Mekong, crossing from the Salween by the Yuragan

*"From the Yangtze to the Irrawaddy," *G.J.*, 62, 1923, pp. 6–20.

†Excluding the crimson Azalea, *Rhododendron indicum*, which grows in the river-bed just north of Myitkyina at an altitude of 800 feet.

Pass, and in the winter they penetrate all these low-lying valleys at the sources of the Irrawaddy. One said he had been four years in the country; but most of them come and go annually; they reinvest their money in the produce of the country, especially skins of flying fox and *hwang lien*, which is the root of *Coptis Teeta*, a valuable febrifuge in the Chinese pharmacopoea, and return to China with loads almost as heavy as those which they brought.

Beyond the Seinghku–Adung confluence the country grows much wilder,

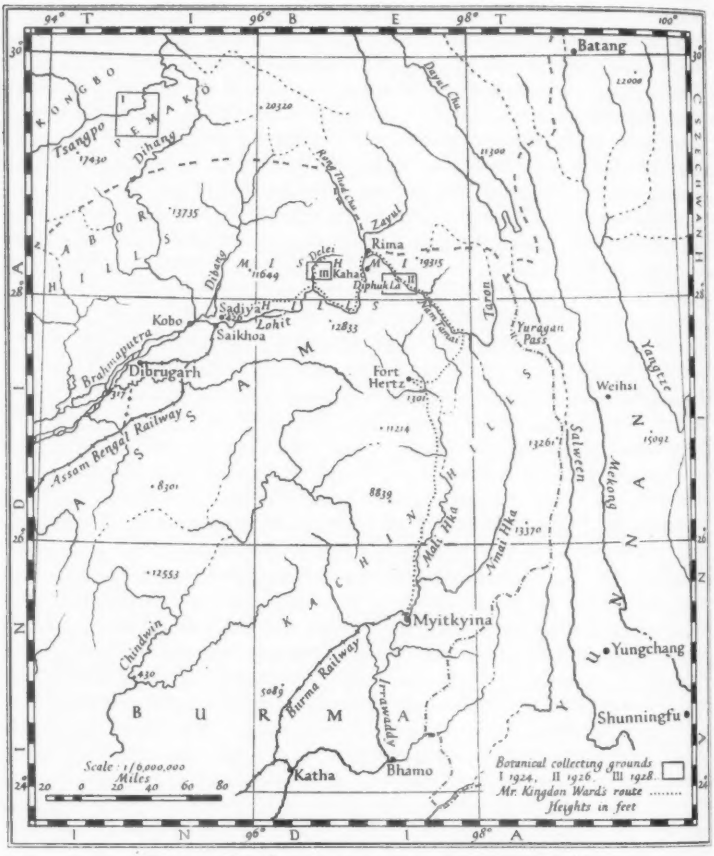


Fig. 1. Sketch-map of the Assam–Burma Border

and is almost uninhabited until the great barrier range of the Irrawaddy-Lohit divide is crossed. The most frequented path is that up the Seinghku valley, over the Diphuk La (14,200 feet), and down the valley of the Di Chu to Rima. The first march up the Seinghku is the most difficult. At 5000 feet we reached a village of four scattered huts, Nung, Lisu, and Chinese. Here we halted a week; not till May 22 were we able to push on another stage. This

march was easier, and it was surprising to find the valley, instead of becoming wilder, take on a much more habitable appearance. Finally, we reached a Tibetan settlement of several villages, on both banks of the river; twelve or fifteen huts in all, with a total population of perhaps fifty. This is the last settlement in the Seinghku valley: altitude roughly 6500 feet. It was certainly strange to find this Tibetan colony here. The people are immigrants from Zayul, on the other side of the range; they dress like Tibetans, speak a dialect of Tibetan, and in fact are Tibetans, using the term broadly. Their chief claim to notice, however, is the fact that they have crossed the great climatic barrier of the Irrawaddy–Lohit divide, and live as low down as 7000 feet. Generally speaking, the Tibetans do not thrive much below 10,000 feet; but that is only because the conditions for a pastoral life in this part of Asia are not as a rule found below that level. Zayul however is exceptional, and there are many Tibetan villages in the Lohit valley and its tributaries much lower down. On the other hand, the tribes of the upper Irrawaddy and of the Assam frontier never live above about 5000 feet, or cultivate land above 6000 feet. Maize will not ripen above the higher level, and the slopes are too steep for cultivation, the rock too close to the surface. Consequently, there is usually a wide gap between the agricultural tribal belt, towards the foot of the escarpment, and the pastoral Tibetan country towards the top. I was lucky to strike an intermediate village such as this, with all the advantages of the Tibetan system; that is to say, permanent cultivation and pasture, flocks of sheep and goats, herds of yak and cattle, affording supplies of meat, butter and milk, as well as some surplus grain: maize and barley. The famine below had passed them by unscathed. The huts here were of timber, roofed with shingles, as in the wetter parts of Eastern Tibet, *e.g.* Kongbo and Pemakö. Thanks to the pastures by the river and the cultivation on the flanks of the hills, the valley was quite open; and as we were now close to the Alps, the forest was temperate.

The Tibetans had built me a log hut, thatched with leaves on a bamboo frame, on the river-bank, and here I made my base camp for six months. The next step was to build an alpine hut farther up the valley, and to move up supplies, as soon as the snow melted sufficiently, for a couple of months' stay. The point chosen was the last river junction, about 8 miles up the valley at an altitude of 11,000 feet; a long day's march, though laden coolies required a day and a half. At Haita (base camp) the Seinghku is a roaring torrent, choked with huge blocks of granite, and the gradient is steep. A wooden cantilever bridge spans it at this point, connecting the villages on either bank. This bridge was carried away during an exceptional rise of the river at the end of July 1926.

Towards the end of May the Tibetans drove their flocks and herds up the valley, and by June 1 I had secured transport to carry some of our equipment and rations up to the new hut. Cattle and yak, though able to ascend the path —a very bad one—could not carry loads up, so coolies had to be employed. We crossed and recrossed the Seinghku in the lower forest belt, where the huge-leafed *Schefflera Wardii* imparted a tropical look to the vegetation lining the river. There were also several epiphytic species of Rhododendron, including three new ones. Then we ascended very steeply up the left bank, through wonderful temperate rain forest. The trees here were of great size and girth, swaddled in moss, and covered with a variety of epiphytes; notable trees were

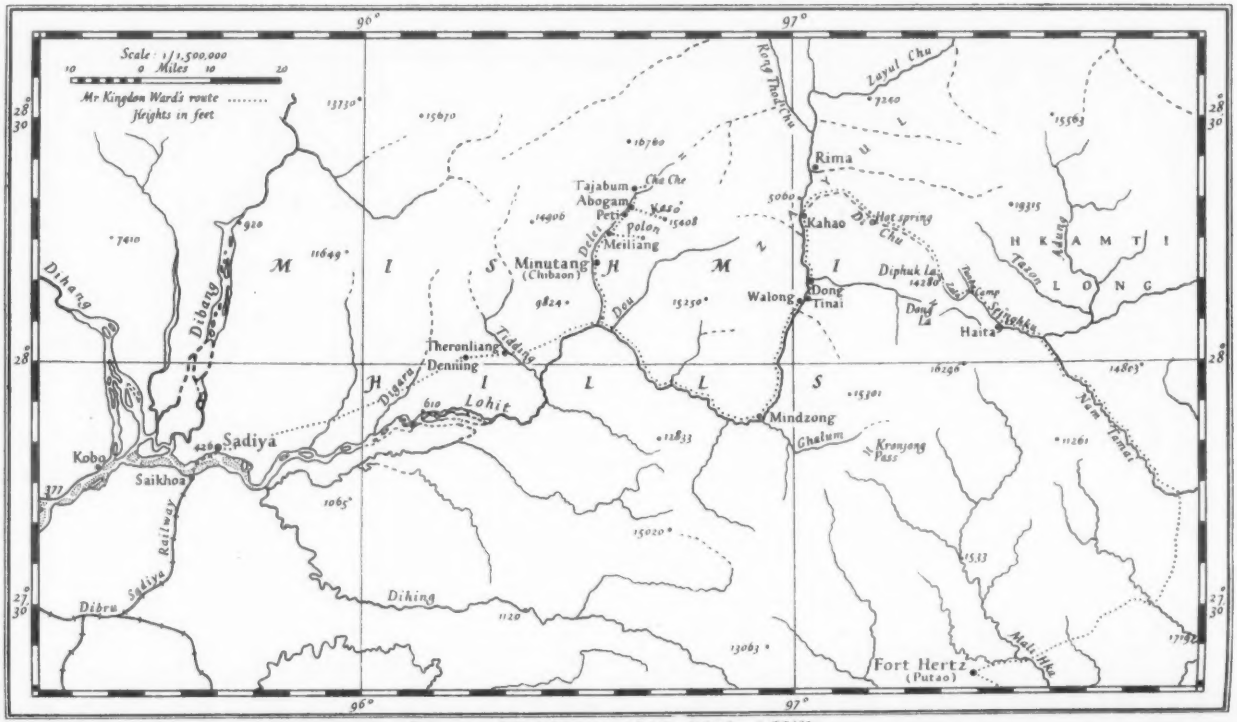


Fig. 2. Sketch-map of the Mishmi Hills

species of Oak and Cinnamomum, Spruce (*Tsuga*), *Magnolia Campbellii*, *M. rostrata*, *Rhododendron sino-grande*, and *Ilex notofagifolia*. In the evening we reached the first group of bothies, on the fringe of the forest. There was an immense accumulation of snow here, forming a bridge over the roaring river, and, as the hillsides were scarlet with Rhododendron, I decided to spend a few days here with the sheep and the goats before going on to my hut.

Every day the sheep and the goats trotted up one or other of the two big snow cones which filled opposite gullies and coalesced below to form the bridge over the river. There were a few cattle here, too, and more at the next camp, a little way up the valley. On the Survey of India Sheet 91 (1919–1920) this is marked as a village, Sakongdām; but it is really only a temporary cattle camp. There are five such camps in the Seinghku valley and its tributary the Tunba; the lowest at 9000, the highest at 12,000 feet, just below the Diphuk La. The animals are driven up gradually as the snow melts in June and return to the village pastures in October.

Ten days later we moved up the valley to the junction of the Tunba and Zala streams, where in the angle there were several bothies. Up both branches there was a tremendous accumulation of snow, and it was many days before this melted. However there were lots of alpine flowers, and for the next four weeks I lived here and botanized on the surrounding mountains. About 2 miles up the smaller Tunba branch, which flowed from the north, at a height of 12,000 feet was another encampment, not yet occupied. The map shows a path up this side valley, crossing the range at its head and descending to a tributary of the Adung river. No such path exists. A cattle path does indeed go up the Tunba valley as far as the bothies, but not beyond; indeed, the head of the valley is surrounded by such high precipitous cliffs that it is almost impossible to get out of it. At my camp (11,000 feet) there were toads living under a rock in the icy-cold stream.

Up the main valley the last encampment was found in sight of the pass, at 12,000 feet. I was now on the Irrawaddy–Lohit divide at last, and the alpine flora proved to be both interesting and varied. There were many new species of Primula, Rhododendron, Saxifraga and other genera; and the locality proved to be the meeting-ground of Chinese and Himalayan (especially Sikkim) plants. It must be remembered however that alpine plants are usually gregarious, and though they do not take up much room, and space appears to be unlimited, nevertheless the same species continually recur. Most genera are represented by several, and some by very many species; so that on the whole the alps are much poorer in genera than the temperate rain forest.

The most interesting features of the upper valley were the obvious signs of recent glaciation. The Seinghku glacier must have ended at about 9000 feet, where we first camped, and was 10 miles long. Although the highest peaks in the immediate neighbourhood are over 17,000 feet, there are no glaciers now; but in October I noticed several permanent snow-beds between 16,000 and 17,000 feet altitude. There are also glacier lakes on both sides of the Diphuk La, and a number of moraines.

One must picture an entirely different scene when the whole country was under snow and ice. Travelling up the valley, one sees the steep flanks of the V rising abruptly from the torrent at an angle of 60° for perhaps 2000 feet and

Fig. 2. Sketch-map of the Mishmi Hills

ending in a row of stacks along the skyline. No high peaks are visible, though one can see some distance up the valley, as there are practically no spurs; frequently the bottom of the valley is bounded by cliffs, and many a torrent cascades into the main stream from some hanging valley. One naturally wonders where all the water comes from after the snow has melted; for some of the torrents are quite big, though they do not appear to have come far.

If however we climb one of the long screes towards the summit ridge, the secret is revealed. The country as it opens out now assumes quite a different appearance, and we find ourselves on a sort of ledge or shelf. The precipitous slope of the V has eased off, and some distance back are the high peaks of the divide, invisible from the deep valley on account of the change of slope; the stacks we saw against the sky were only the relative summits, marking the change of angle, and cutting off what lay behind.

It is clear that we are now on the ice-shelf, which is all that remains of the ancient plateau, and that when the valleys were occupied by glaciers this was the floor. But the glaciers have long since disappeared, and streams have cut

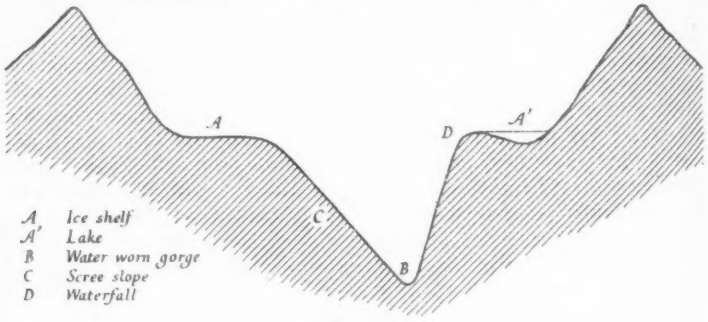


Fig. 3

deep V-shaped grooves in the old plateau floor, leaving only a narrow shelf on either side. Sometimes one finds a lake basin hung up in the air, on the ice-shelf. This structure is illustrated in Fig. 3. That this is the true explanation receives confirmation from a rather unexpected source, the flora of the alps.

The alpine flora of the Himalaya, and of Tibet and Western China, has been somewhat loosely compared with the Arctic flora. The similarity is perhaps more apparent than real; but in so far as an Arctic type is developed in these lofty mountains, it is practically confined to the ice-shelf, being found throughout the Himalaya, in Tibet, on the Assam and Burma frontiers, and in Szechwan and Yunnan, always in connection with a recently glaciated area. The Arctic type of plant is usually in the form of a tight rosette, more or less hairy, or a cushion, or a carpet; and although no species of plants are common to the Arctic and to the Himalaya, similar conditions have produced similar structures. The curious thing is that although the flora of the shelf and that of the valley are in contact, they scarcely overlap. As a practical point, it may be mentioned that plants from the ice-shelf are never hardy in Britain.

Before the glaciers disappeared and the rivers cut their deep V-shaped

notches in the old plateau floor, isolating great blocks of mountainous country, the high alpine flora had spread over the whole plateau, from the Karakoram in the west to Szechwan in the east. There is no such free communication now, since the big rivers drilled their gorges through the ranges between the plateaux and the plains; and we may conclude that the "Arctic" alpine flora is older than the sub-alpine flora, most of the species of which have a much more limited distribution.

Of the botanical results obtained in the Seinghku valley it is not necessary to say much here. Perhaps even more interesting than the discovery of many new species was the occurrence of several alpine Sikkim plants as far east as the headwaters of the Irrawaddy, notably *Primula Wattii*, *P. moschata*, and *Rhododendron pumilum*.

Except at the extreme head of the valley the rocks of the Seinghku are all gneisses and schists, with phyllites, quartzites, etc. I have however already mentioned a limestone ridge on the right bank of the river, opposite to our base camp. This ridge runs almost north-west, and a high bare conical cliff, just above the Tibetan village, is one of the most conspicuous landmarks in the Seinghku valley. Eventually the river cuts across this belt near the head of the valley, where a row of limestone peaks is a feature of the landscape. As far as the Diphuk La itself the limestone keeps to the west of the route, but after crossing the pass and descending about 1500 feet, one finds oneself on the limestone, and after a day's march off it again. The Di Chu, as the stream which rises on the other side of the range is called, flows north-east, so that one crosses the limestone belt diagonally; it is not really so broad as it seems. Farther south, on the west or right bank of the Nam Tamai, according to Dr. Murray Stuart,* are outcrops of "highly siliceous calcareous rocks, white in colour, with slaty cleavage planes almost vertical, and weathering into extremely steep jagged peaks." The above description, though it has reference to a minor range not exceeding 10,000 feet, fairly describes the limestone range of the Seinghku, 12 or 15 miles to the north-west, which is a direct continuation of the Nam Tamai range. It is almost certainly the same rock, the general strike of which is north-west; on the upper Seinghku the limestone appears to dip west at angles of 70°–80°. This belt of crystalline limestone greatly increased the richness of the alpine flora, as many plants were found on this rock and nowhere else. There was another reason however for the unusual wealth of the flora in this region: the fact that the Irrawaddy–Lohit divide is a climatic barrier comparable to the Great Himalayan range. Every one who has travelled by the Tibet road through Sikkim must have noticed how the type of forest changes on the other side of the Nathu La, or Jelap La; a similar change takes place on the other side of the Diphuk La. Indeed, it was the presence of a typical dry alpine flora along the crest of the range which first hinted that the divide was a climatic barrier. This was supported by direct observation of the weather in a rather striking manner. Both in June and July I frequently noticed that if I went up the main valley and climbed to about 14,000 feet, the weather improved. Often the sun would be shining over the Diphuk La and on the 16,000-feet peaks all round, when it was raining steadily at 11,000–12,000 feet; and looking down the valley towards my camp I would see a heavy bank of mist shrouding

*Records of the Geological Survey of India, 1919.

the lower peaks, but sharply cut off above, leaving the whole head of the valley in sunshine.

This could only be due to dry air sweeping over the passes from the plateau behind; and it was obvious that there was quite a different flora on the other side of the barrier awaiting investigation. The fact that there is a dry alpine (Sino-Himalayan) flora on the Zayul side, and that a few species have crossed the passes and crept down a short distance on the Burma side, seems to prove a progressive advance of plateau conditions from that direction, such as would in fact accompany a retreat of the ice. There can, in fact, be no doubt that the retreat of the glaciers on the Irrawaddy–Lohit divide, as on the ranges farther east, is due to a smaller precipitation than formerly; but what has brought about the diminution is not so clear.

After spending a few days at the highest yak camp (12,000 feet), where the Seinghku divides for the last time, we started for the Lohit on July 11. The map marks two paths, one up either branch, that via the Diphuk La in a general north-east direction being the main track to Rima. If the second one, via the Dong La, existed, it would be the shortest route to the Mishmi Hills and Assam. Unfortunately it does not exist. Possibly hunters sometimes make their way across the range by this route; but then hunters, carrying practically nothing, can cross the range almost anywhere.

There are two high steps up to the Diphuk La, each once probably occupied by a lake. The only lake I saw on this side, however, is high up in a hanging valley on the limestone range to the west of the pass. No view is obtained from the summit, and to see the group of 19,000-feet peaks 20 miles away to the north-east it would be necessary to climb to the top of the divide between the Seinghku and the next river to the north, the Tazon, a tributary of the Adung. But beyond the Diphuk La and right away northwards and westwards the country is not only unsurveyed but unexplored; there is plenty of room here, within an area of many hundred square miles of mountainous country, for several peaks of over 19,000 feet.

From the Diphuk La to the first glacier lake (about 13,000 feet) is almost precipitous. Below that, another abrupt drop of about 300 feet brings us to a second glacier lake, below which is yet another step down. The rocks of this latter step or escarpment still retain very clearly their ice-worn appearance. At about 12,000 feet a stream from the east joins in, and below this point the Di Chu is unfordable during the rainy season. There is a good camping site here.

For the next two days' march to the hot springs there is no path. The valley bottom is a bog, and we found both sandflies and mosquitos very bad. We were not troubled with either in the Seinghku valley at the same height. It is probably for these reasons that the Di Chu valley is entirely uninhabited, even during the summer. Another reason may be that yak and cattle cannot climb up into the valley from the Lohit. However that may be, we saw no sign of grazing during the six days' march.

A little above the hot springs, where Colonel Bailey shot takin in 1911, there was a snow bridge across the Di Chu, at 10,000–11,000 feet. Below the hot spring, at an altitude of 8000–9000 feet, was another large drift—this on July 15. The granite cliffs here are almost vertical, and vast accumulations of snow must be shot down the chutes into the narrow gorge. We reached the hot springs on

Looking down the Seinghku valley from below highest camp

Looking up the Lohit valley from Dong

The Lohit valley above Mindzong: Mishmi cultivation on river terrace in foreground

July 13. They are on the left bank, just above the river, the warm water welling up from beneath the boulders. There is a faint smell of sulphur. All round the mud is trampled by takin. Thus below the glacier cirque, which is very similar on both sides of the range, the two valleys are in strong contrast to one another; and the difference is emphasized by the different type of forest on the Zayul side. Here there is no temperate rain forest; conifer forest passes directly into arid pine forest below, and the drier climate is further shown by the lichen instead of moss which flutters from the trees.

Between the foot of the cirque and the hot springs I noticed only one obvious moraine; below the hot springs there are no clear signs of ice action. The Di Chu valley becomes more and more of a ravine as the river plunges down towards the arid Lohit, and all trees except *Pinus khasia* presently disappear. There is a distinct path from the hot springs down; nevertheless the torrents which cascade into the ravine on the right bank are unbridged, and in the rainy season difficult to cross. The rock is all granite.

On July 15 we reached the end of the forest. It was interesting to observe a close resemblance between the forest trees and shrubs here and those of Kongbo at the head of the Tsangpo gorge, 200 miles to the north-west. The ravine opens out in a funnel-like mouth, flanked by high granite cliffs, to which an execrable path clings dizzily, while the torrent plunges down into the bowels of the mountain.

From a terrace, where there is a water-hole, the Lohit comes into view 1000 or 1500 feet below, and the path forks. The path which descends to the right goes to Rima, that to the left goes to Kahao, where we arrived the same evening. It is a good day's march up the valley from Kahao to Rima.

At Kahao I spent five days. It was extremely hot, but dry, the altitude being about 4000 feet. Rice is cultivated here, and I saw Mishmis for the first time. The first Mishmi village is about three days' march down the valley, but in the rainy season men and women come up to work in Rima. They do not cross the Diphuk La, or even go up to the hot springs; the shooting rights there are jealously guarded by the Tibetans.

The most remarkable feature of the Lohit gorge was the violent hot wind which sprang up about midday and raged till dark, and sometimes till late at night. It blew northwards towards the plateau, and was very irritating. When it rained (which it did only once) the wind did not blow, but usually the weather was fine.

On July 22 we started back, halting a day at the hot springs, and reaching my camp on the 28th and Haita on the 31st. The weather was fine until we crossed the pass, when it turned very wet again. The Seinghku was in flood, and part of the path had been washed away as well as the bridge at Haita.

The Di Chu valley is about 30 miles long (as against 25 miles for the Seinghku) and may be divided into four sections: (i) the cirque at the head, from the pass to the first big confluence, with glacier lakes and ice steps; about 4 miles, with a descent of 2500 feet. (ii) The upper ice-worn portion, rather level except for one or two sudden descents down moraines, boggy ; about 10 miles from the confluence to the hot springs, with a descent of about 1500 feet. (iii) The lower water-worn ravine from the hot springs to the end of the forest; about 12 miles, with a descent of 2000 feet. (iv) The funnel-shaped mouth; about 4 miles, with a descent of 4500 feet.

The Lohit valley above Mindzong: Mishmi cultivation on river terrace in foreground

Looking up the Lohit valley from Dong

It is interesting also to compare the Nam Tamai with the Lohit, the two rivers flowing on opposite sides of this almost completely unexplored range, each at an altitude of 3000–4000 feet where I saw them. The latter is of course much the bigger stream. The valley of the Nam Tamai is filled with dense jungle, its steep slopes cultivated on the *taungya* system, its principal crop maize; the Lohit is almost treeless, except for scattered pines, with permanent rice cultivation on irrigated terraces.

In August I returned to Fort Hertz, getting back to Haita in the middle of September. Soon after the beginning of October the monsoon ceased, and we enjoyed a fortnight's glorious weather in the high alps. Then came a four days' storm and another spell of fine weather.

On October 30 we started for the Lohit, meaning to march through to Assam. The weather was bad: it was raining in the lower valley, and next day it was snowing in the alps, but when we crossed the Diphuk La it showed signs of clearing. Only a very little snow had fallen on the Burma side of the pass, and that melted in the course of the day. I was therefore considerably astonished, on reaching the pass, to find the Zayul side under deep snow. The vanguard of my party, consisting of four coolies, two servants and myself, camped in the snow at the junction of the two streams. The other sixteen coolies did not arrive that evening, nor the next morning, and later in the day we discovered that soon after crossing the pass they had thrown their loads down in the snow and bolted back to the Seinghku valley.

In the course of the next six days we relayed the loads down the valley to the hot springs, where they would be comparatively safe, though there was snow here too under the trees, so severe had the storm been. Luckily the weather was now gloriously fine, with bright sunshine by day. Leaving most of the baggage at the hot springs, we pushed on to the Lohit with as much as we could carry, arriving at Kahao on November 11. When at Kahao in July I had written a note to the Political Officer at Sadiya, and entrusted it to the local headman, telling him to send it on to the next village, and so on, village by village, to Sadiya. This note actually reached the Political Officer in September, and he had sent a Mishmi guide up to meet me at Kahao. The man had arrived early in November, waited four days for me, and hearing no news of us, had returned to his village, leaving a note from the Political Officer, which was now handed to me. This gave me the necessary information, and the marches to the Lohit Valley Road; I was also warned that I must be self-contained, as I could get no food in the Mishmi Hills. However it was some days before we were able to start, after sending men to the hot springs to bring in the rest of the baggage. At last on November 24 we started down the Lohit, with six Tibetans in addition to our own party. The path was bad, terraces, covered with pines and grass, alternating with cliffs; the terraces being waterless are not cultivated, and we saw neither houses nor fields on either bank all day. The numerous streams have either cut deep below the terrace-level, emerging from a gorge in the cliffs, or they cascade over the smooth slab-like wall of the valley. On the following day we reached Dong, and later Tinai, where we had to cross the river by a rope bridge. The crossing, on November 26, took three hours, and soon after leaving Walong—the last Tibetan village—we camped again.

Between Dong and Tinai is the last considerable terrace, with a good view up

the Lohit gorge from its edge. It has rather the appearance of a moraine, and it is not difficult to believe that the Lohit from this point northwards has been ice-worn; at any rate, the river once flowed at a much higher level than it does now. Below Walong the appearance of the valley is entirely altered, and jungle replaces the thin pine forest of the dry region.

On November 27 we reached the first Mishmi village; we also passed a granite boulder on which was cut: "5th Coy. 1st K.G.O. Sappers and Miners 1912." Appropriately enough the track began to improve. Though quite narrow expert work had obviously been done on it, and there were stone revetments as solid as on the day they were built, fourteen years previously. However this did not last; the path was soon completely overgrown, and we found ourselves following the Mishimi track. Walong was the farthest point reached by the expedition of 1912; the country is now "unadministered territory."

Three days later we reached Mindzong, where the Lohit makes its right-angled turn to the west, and the Ghalum stream rushes in on the left bank. Four more days' marching brought us to the Dou river, and continuing another mile we camped in the bed of the Delei, these two rivers flowing in from the north. The valley is here more thickly populated. Several of the "rope" bridges hereabouts were made of telegraph wire, nine separate strands. The Mishmis, when using a material to which they were unaccustomed, had no intention of taking unnecessary risks.

The suspension bridges thrown across the Dou and Delei rivers by the sappers were in picturesque ruins; but the cables were still in place, though one supporting the Delei bridge had sagged. It was still possible for men to cross, but not for mules.

It is three marches from the Delei to the first bungalow at Theronliang, on the Tidding river; but as we had almost finished our food we had to go through by forced marches in two days, reaching Theronliang at 8 p.m. on the night of December 6. We were now on the Lohit Valley Road, just over the administrative frontier, and 75 miles from Sadiya. On the following day we crossed the Tidding Saddle, 6000 feet, and on the 8th descended to Denning outpost on the edge of the plain. There is a dry-weather motor road from here to Sadiya; but we had to walk another 24 miles to the Digaru river, which is impassable for cars except at very low water. On the far side the Political Officer met me and drove me in to Sadiya the same afternoon, 9 December 1926. And so ended the Seinghku Valley expedition.

THE DELEI VALLEY EXPEDITION, 1928

The Mishmi Hills are "unadministered territory." No botanist, and indeed no scientific traveller, had travelled in the country since Griffiths' time, in 1836, although several Europeans have visited Rima within recent years, including Mr. Dundas, Colonel F. M. Bailey, and Mr. T. P. M. O'Callaghan. Cooper in 1872 had penetrated up the Lohit almost as far as Mindzong.

Three rivers debouch into the funnel-like head of the Assam valley to form the Brahmaputra. They are, from west to east: (i) the Dihang, (ii) the Dibang, and (iii) the Lohit, all flowing, in the main, from the north. The Lohit is particularly interesting because in its upper reaches it flows close to the Salween,

separated from it by a high but narrow range of mountains; and in its middle course it flows equally close to the Irrawaddy, which meanwhile has risen between the two.

At intervals round the arc of foothills which form the head of the Assam valley are three frontier outposts, two of them permanent, the third withdrawn during the rainy season, and beyond lies unadministered territory stretching away to the actual frontier and inhabited by various independent tribes. An imaginary "inner line" is drawn between administered and independent territory, and no European is allowed to cross the line without special permission. Naturally such permission is rarely, and for the Abor country never, granted. The Digaru and Meju Mishmis are however regarded as at least harmless, if not effusively friendly; whereas the Chulikata and Bebejiya clans are not. The former inhabit the hills enclosing the Lohit near its exit, the latter the valleys of the Dibang and its tributaries. The Indian Government kindly granted permission to Mr. H. M. Clutterbuck and myself to spend eight months in the Lohit valley, and the Political Officer, Sadiya Frontier Tract, gave us such assistance as lay in his power.

The field of operations selected for botanical work was the Delei valley, the confluence of which with the Lohit I had reached in December 1926 as described above. It has already been remarked that the Lohit valley, above Kahao, is almost treeless, and that as far down as Walong the climate is arid. Below Walong a change sets in gradually, but even as far south as Mindzong, where the river turns westwards, pine forest is prominent everywhere except immediately along the river's edge. Nor is that all. Pine trees do not entirely disappear even after the river has made its great bend to the west, and on the second march below Mindzong we had crossed a pine-clad terrace at no great height above the river. Marching up the Lohit from Sadiya therefore, after entering the gorge one would soon notice the increasing aridity, and on turning the corner at Mindzong, the change would be pronounced. Therefore, I argued, the same change to drier conditions would be found if one went northwards up the Delei valley instead of up the main valley which lies some 35 miles farther east, four days' march. The Delei valley being only three marches from the Tidding river and administered territory, we could, I argued, reach the Pine country a fortnight after leaving Sadiya, allowing a full week's marching up the Delei valley. Whether the argument was sound or not is now immaterial; as a matter of fact we never saw a pine tree up the Delei, which is filled to its head with Indo-Malayan jungle. But it was then too late to change our plans.

Although the Delei and Dou valleys had been surveyed right up to and round the horseshoe of high peaks which encircle them, by the Mishmi Hills Expedition of 1911–12, yet no report on the country was forthcoming, and we have the unusual circumstance that a piece of territory, fairly accurately mapped on the $\frac{1}{4}$-inch scale, is yet completely undescribed. Captain Hardcastle, who was in charge of the Delei valley survey detachment, actually ascended to within a few miles of the pass at the head of the valley, which was fixed; but there is no information about the country in the (confidential) report subsequently printed, although a very little might have conveyed much to a botanist. The great difference in the vegetation of the Delei valley and that of the Lohit in the same latitude may confidently be ascribed to the fact that the former is a

local re-entrant, whereas the Lohit rises on the plateau behind the line of high peaks, giving it a much drier climate in its upper course.

Clutterbuck and I left Sadiya on March 1, and on the 2nd we reached Denning, an outpost at the foot of the Mishmi Hills. Denning stands at an altitude of 2290 feet, and on a clear day there is a fine view across the slanting forest-covered plain to the Lohit. The monsoon, sweeping up from the west, strikes against the first hill range, and Denning is consequently treated to an enormous but very irregular annual rainfall. In 1925 it was 269 inches; in 1926, only 217 inches; then in 1927 it rose to 313 inches, when tremendous damage was done to the road; 24 inches of rain fell on July 7, and there were numerous extensive slips.

Theronliang, the last bungalow, was reached on March 6, and then came a halt while coolies were being collected. The loads were sent off as fast as the Mishmis arrived, and on the 13th we moved on, reaching the Delei river on the 15th. Then came a long halt. Most of the Mishmis were away on the plain, and every day large numbers passed through our camp on their way back to their homes. All were heavily laden. Many of them drove cattle, bought in Sadiya, and no doubt a great source of wealth to the Indian settlers there. Some Tibetans also passed by, and on April 1 over fifty people came along. A few Tibetans, carrying heavy loads of cloth and musk, went through on their way to Sadiya; but the majority were returning from the plains.

Owing to the scarcity of coolies and to a week's rain, three weeks elapsed before we were able to follow our loads up the Delei valley. The track was very bad, either over boulders in the river-bed or up and down the cliffs by notched logs and bamboo ladders, holding on to creepers for support. On the second day we left the river-bed, and ascending steeply for 1000 feet reached the large village (thirty huts) of Minutang—Chibaon on the Survey sheet. Here we halted a fortnight, and climbed up to the temperate forest belt, where we found Rhododendrons in bloom.

The Mishmi hut is long and low browed, built of bamboo heavily thatched with grass. Like all jungle huts it is raised a few feet off the ground, which moreover is rarely level and often steep; but the underpart is fenced round. Often there is an outer thickset fence of bamboo higher than the roof; beans are grown up these stakes, and the whole forms a screen through which the inhabitants of the hut can watch passers-by while themselves remaining invisible. The interior of the hut is divided off into rooms, each with a side door opening under the low eave. The rounded front porch is a characteristic Mishmi feature. The huts are never crowded together like Abor huts, but are surrounded by cultivation, with a few scattered trees left standing apparently for shade; *Albizzia Julibrissin* is possibly planted at Minutang for this purpose. No Mishmi village, however, approaches the average Abor village in size.

The fermented liquor (*apong*) so beloved of the Abors is almost unknown in the Mishmi Hills, and we were rather surprised to find that no alcoholic drink is brewed in the Delei valley above Minutang. Their particular vice is opium, which most of the men take regularly. Almost every hut has its patch of poppy, and these were now in flower. A month later the capsules were being scratched by women and the exuding juice wiped off on rags. The dope is of course drunk, not smoked. Peach trees are common in the villages, and soapy

bananas are grown in the subtropical parts of the valley. Sweet potatoes were common, and we were able to buy them throughout April and May, together with peas and later beans; also a kind of spinach. Maize and buckwheat are the principal crops, and some Eleusine is also grown. The commonest vegetable, after those mentioned above, is a species of Colocasia, which is grown mixed with other crops.

In the Lohit river we had seen large numbers of fish, and also in the Delei near the old bridge where our camp was situated; otters and cormorants, which also appeared to be plentiful, testified to their abundance. Whether there are fish in the upper Delei or not we had few opportunities of judging, as we did not approach the river again after Minutang until we crossed it, a roaring torrent, near its source in the middle of May. The Mishmi method of catching fish is to attract them at night with a torch, and spear them. We saw no traps. We found cattle in the upper valley, chiefly mithan. These could not have come by the river path, and there is in fact an alternative path higher up.

On April 19 we left Minutang, and crossing a deep ravine reached a village on the opposite spur. The following morning was fine, and from the shoulder above we had a fine view up the valley, the mountains all covered with snow; but there was no hint of any change in the vegetation. After a long traverse round the side of the mountain in dense forest we reached a spur, and descended 1500 feet to a cultivated flat by another large stream, and camped. The adjacent village of Meiliang was a mile down the valley, by the Lohit. Overlooking us was a high peak called Polon, covered with snow.

The *Gam* of Meiliang was friendly, and produced coolies more promptly than any Mishmi had done hitherto; perhaps because he was anxious to get rid of us. We spent only five days in this camp, and were able to ascend the ridge to an altitude of about 9000 feet, finding several more Rhododendrons in flower.

On April 26 we moved on again, crossed another big torrent, and in the afternoon found ourselves in a more thickly populated country. Approaching the crest of a high spur, we quite expected to see from the top pine trees and other evidence of a drier climate. Other evidence there certainly was, of a sort, but never a pine tree. The climate of this upper (inhabited) valley is perhaps a little drier than that of the lower valley, and the villages are necessarily higher up, mostly between 5000 and 6000 feet altitude, on the lesser slopes and undulating terraces above the river. The Mishmis are warmly clad in thick Tibetan woollen cloth and skins of goral. The mountains are terrifically steep, exposing large slabs of bare rock, and long cliffs are laid bare, every side stream falling hundreds of feet over the escarpment. There was plenty of snow on the surrounding peaks, and it was consequently cold in camp, especially when the weather turned wet for five days.

The principal spring crop is barley. Sir Rowland Biffin, to whom I sent specimens, informs me that there are two very distinct varieties of barley involved: (i) *Hordeum vulgare*, var. *himalayense*—common, more or less widely distributed in the Himalaya. (ii) *H. intermedium*—(an awnless barley), belonging to a rare and little-known group, and differing from any barleys hitherto described in certain technical, definitely Himalayan characters. There can, I think, be little doubt that the Mishmis have derived their barleys from the province of Zayul.

We halted at Peti,* a village overlooking the last big division of the Delei; the north-west branch is uninhabited, but there are several small villages up the main branch from the north-east. Due east of us and 6 miles distant as the crow flies was the peak called Kasomathag, or Kaso, 15,408 feet, on the Dou–Delei divide.

We had to camp in the midst of cultivation at Peti, and the Mishmis were not particularly effusive in their welcome of us. While waiting to proceed we climbed the neighbouring slopes, where we found many trees in bloom in the temperate rain forest. Cultivation extends to about 6000 feet, above which is the forest. Considering the wealth of species it is surprising how little comes out of these forests. The chief product is *Coptis Teeta*, the root of which is collected and sold in Sadiya at the rate of about seven shillings a pound. It goes to China, where it is used as a febrifuge. The Mishmis make clearings in the forest to encourage its growth, mostly between 7000–8000 feet altitude.

The Mishmis appear to be neither keen nor expert hunters, though game is not scarce. We only saw one man with a gun, and it was all he could do to shoot us a green pigeon in the valley. Not every village indulges in hunting, only those apparently which happen to be situated at the foot of a convenient spur whence the alpine region can be reached. The village then owns all the rights for that territory, but only two or three men are professional hunters. Everything is trapped; goral and blood pheasants are the principal game; a few musk deer, perhaps. Wild honey is also collected. Monkeys abound in the lower forests, and these, with bear and deer, take toll of the maize crop in the summer, calling for constant vigilance, day and night, on the part of the agriculturists.

On May 3 we walked to the crest of the next spur on the other side of a deep ravine, up which were several fine cascades. From there we saw the Delei thundering through a deep gorge, high up on whose face lay our path. This proved to be a succession of climbs up and down rickety ladders, and along ledges; we were hardly surprised that the Mishmis had declined to go until the rain stopped.

At Peti we drew water from small brooks which coursed down the slope; but at the village across the ravine there were no brooks, and the inhabitants got their water from wells, or rather springs which filled shallow artificial basins scattered along the foot of the slope. We were told that a footbridge across the river higher up had just been washed away, and that it would be necessary to put a bamboo rope bridge in position; so our progress up the valley was delayed till May 8. That evening we camped by the river again almost opposite to the last village, on the right bank. The following day we crossed the Delei for the first time, passed through Tajabum (three huts), descended into a ravine and crossed a big torrent by an entirely inadequate footbridge which had just been put in position for us: we did not cross dry shod. A stiff climb up the opposite cliff brought us to a narrow ledge of rock, and here we were asked to camp. There was not room to pitch the two tents, barely room for a fire, necessarily in the open, and no room at all for drying clothes, botanical paper, or anything else. In fine weather, or for a few nights, it was adequate; as a base camp for serious work it was hopeless. This place was called Cha Che, and was the

*Tablekon on the Survey Sheet.

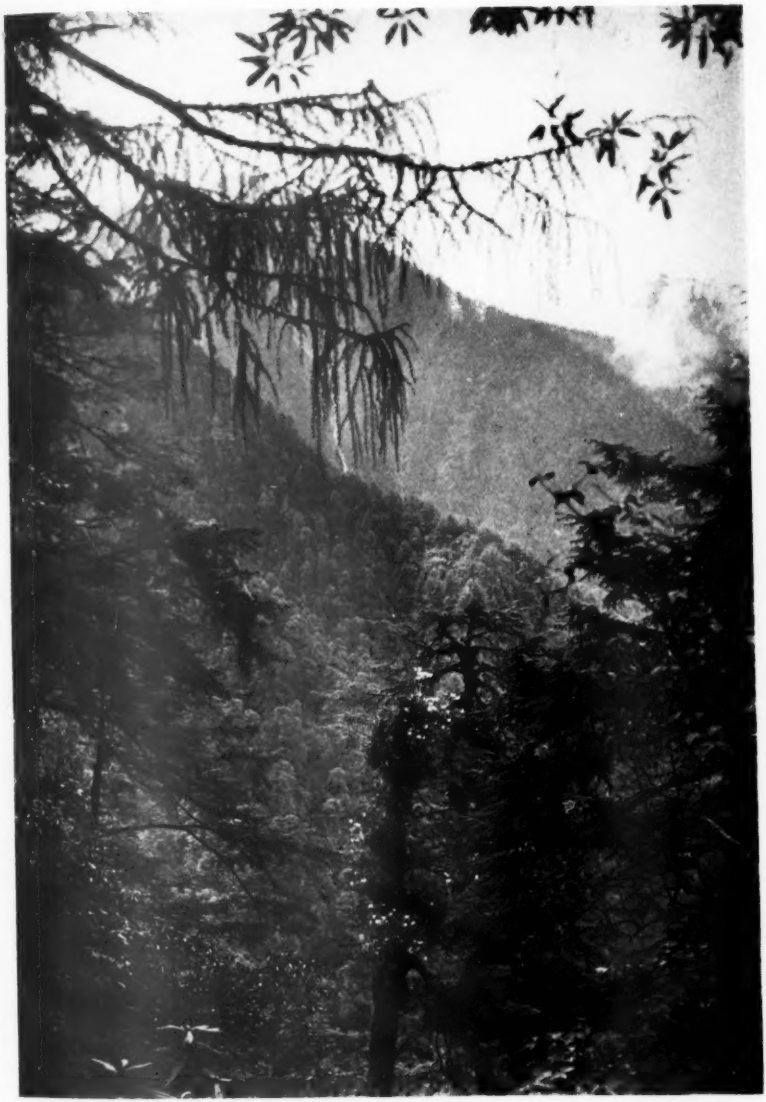
farthest point up the valley reached by the Survey detachment in January 1912, who spoke well of it. Our altitude was perhaps 6500 feet, and we were considerably less than 10 miles from the pass in an air line, but fully two days' march nevertheless. The Mishmis refused to take us any farther up the valley, saying that it was impossible to cross the torrents now that the snow was melting, or, having crossed them, to get back safely. A few days later I had reason to know that what they said was true.

We returned to the rope bridge and camped there for several days. At first the weather was fine, and the damp heat was extremely trying even in May; but rain came on again before long. I explored up the valley beyond Cha Che one wet day, crossing the torrent dry shod and ascending over 2000 feet up the cliff. There was a well-marked path beyond, with the remains of camp fires, but no possible place where a body of men could have slept even one night. From high up on the shoulder I had a fair view up the valley almost to the pass, and my worst fears were confirmed. The valley became deeper and more V-shaped all the way—a mere gorge, and was filled with dense forest. It was obviously entirely water worn, and there was no hint that it ever had contained a glacier; there was no vestige of a cirque at its head. Higher up the path descended once more to the river-bank, and there was a small meadow in which it would be possible to establish a permanent camp; but it would probably be a long day's march to the pass even from there, so bad was the going.

Returning to Cha Che, I found that the torrent had risen several feet and was sweeping right over the frail bridge. It was impossible to cross, and had it not been for the arrival of two Mishmis on the opposite bank, sent out by Clutterbuck, who had noticed the rise of the main river, I must have spent the night in the open until the re-freezing of the snow above in the small hours caused a fall in the water-level. The Mishmis threw me a coil of jungle creeper, pushed a stout bamboo across the torrent, fastened their end, and bade me do the same. Thus I crossed in safety.

The rising of these torrents is a point of some practical importance to the traveller, and our experience was that snow was much more effective in causing a sudden rise than rain. As early as March 24, after three days' rain, while camped at the Delei confluence, we had noticed a change in the colour of the water, which became smoky; there was no great rise, however. Then on April 1, after five consecutive rainy days, there was a big rise, the river bringing down a lot of timber and bamboo. This rise however coincided with a general rise of temperature, after a series of sunny days preceding the rain.

The most conspicuous example of how the torrents behave was furnished by the stream below Peti. When we returned to the village from Cha Che, on May 16, we could hardly get across, as the overflow had come down a side channel which was unbridged; we waded across over our knees, holding hands. This was after three days' drizzling rain. When we crossed this torrent again on July 10, returning from our alpine camp, we had no difficulty at all, as there was hardly any water in the overflow channel. It had then been raining persistently for six weeks. In the winter most of these torrents must be dry, or nearly so: even the Delei can be spanned by a temporary bridge from boulder to boulder. In the middle of the summer, usually in the second half of July and the first half of August, there is always a break in the rains of longer or shorter



Temperate rain-forest at 10,000 feet in the Mishmi Hills, with bunches of epiphytic Rhododendrons on the big trees

Looking down the Seinghku valley from lower limit of glaciation

Alpine ridge leading to summit of Kaso: from alpine camp, July 2

duration. The water-level then steadily falls, for though the snow continues to melt it now does so more steadily and regularly, and much of the water is taken up by plants.

The Mishmis then probably spoke the truth when they said it was impossible to go to the pass in May. Even had we been able to bridge the half-dozen furious torrents above Cha Che, the soft deep snow on the slope leading to the pass (which is nearly 13,000 feet) must have prevented us—or rather them. As a matter of fact, the Mishmis go only during the summer break, if at all, and even then they go to hunt, not for trade. On the other hand, the Tibetans cross from the Rong Thod Chu only in November and December. After that the pass is probably blocked by snow. Thus the Delei valley cannot be regarded as a likely route into Assam.

Following our return to Peti we explored a hunter's path which led up the ridge to Kaso, and at an altitude of about 10,000 feet we found a possible camping-ground in the temperate rain forest. After some argument we persuaded the Peti Mishmis to carry a camp up for us, and at the end of May we went into residence. A few days later the monsoon broke in earnest, and the water shortage with which one is always threatened high up on these razor-backed ridges, even in this aqueous country, was averted. Our coming here led to a temporary coldness, if not to an actual feud, between Peti and Abogam, the village on the other side of the ravine whence the path to Kaso actually started. Abogam refused to have anything to do with us, saying that we were poaching on their game preserve. Peti however, who did not hunt, were not averse to helping us out of their village and on to their neighbours' estate, in return for the considerable sum of money they demanded; and being slightly the larger village, they had little to fear from incurring the displeasure of Abogam.

We spent six weeks in our forest camp, the only variation being four days in an alpine camp which we persuaded four Mishmis, with our assistance, to carry still higher for us. This was at the beginning of July, by which time most of the snow, but not all, had melted.

This is not the place to describe in detail our botanical discoveries. It will be enough to say that we found many species of plants definitely Himalayan, others as definitely Chinese, thus forging another link in the east-and-west chain connecting these two areas. We also found a fair number of endemic species new to science. As might be expected in such an inaccessible and uninhabited wilderness, with a wide range of climate and vegetation from subtropical to alpine, insect, bird, and mammal life abound, though the steepness of the mountains and the dense blanket of forest make systematic hunting well-nigh impossible below the alpine level, and the long persistent snow, precipitous slopes, and heavy mist well-nigh impossible above. We saw goral several times, and in the forest other unrecognizable mammals. It was interesting to find woodcock nesting at 12,000 feet. I found eggs on July 3, and in October I came on a flock of Tibetan sand grouse at about the same altitude.

Kaso, so far as we explored it, seemed to be composed of schists in the alpine region, resting on granite; and below that again slate in the forest region. We found no limestone. Although there was no trace of ice action, the alpine region showed very clearly certain characteristic features of prolonged snow pressure and protection from weathering, more particularly on the undulating north

slopes. Even as late as June 17 there was an immense amount of unmelted snow above 13,000 feet, and snow lay deep as low as 12,000 feet by the middle of October. From this the shortness of the season at these altitudes may be inferred, and it is hardly surprising that above 14,000 feet vegetation practically ceases. Since however the snow-line cannot be lower than 16,000 feet, the amount of absolutely barren ground waiting to be colonized by plants which can adapt themselves, or until the climate changes sufficiently to allow of a longer vegetative season, is considerable.

On July 10 we returned to Peti. The Mishmis, who had never been sympathetic, were now definitely unfriendly. Only once previously had a white man come into the Delei valley, and he had lingered less than three weeks; why, then, should we want to stay so long? The authority of the *gams* appeared to be rather sketchy, at least when it came to providing coolies; on the other hand, once a promise was made it was sooner or later fulfilled. The difficulty was to get a Mishmi to commit himself to any promise. If there was a taboo against lying, there appeared to be none against stealing. So far as we were concerned, the Mishmis confined themselves to petty larceny, hanging round the kitchen and pilfering anything they could pick up; but they never had the temerity to enter our tents, even when we were out. Amongst themselves and their neighbours, however, they would steal anything, especially mithan. There was an intervillage case on at the time, three men having stolen and eaten a mithan belonging to a neighbouring village. The rival *gams* discussed the matter and agreed on the compensation to be paid. There was also a story current that three men had crossed the pass and stolen cattle from the Tibetans; but it is difficult to believe that, if anything of the sort did take place, the Tibetans would not come over in force and ravage the whole valley.

Soon after our arrival in Peti there came a break in the rains. All the easy-melting snow had come down before this, and the streams fell off considerably. Now was the time to go to the pass, and from day to day we heard of individuals who were going there—whether to hunt or to steal cattle seemed doubtful. But no large body went, so far as we could ascertain, and no one would carry any loads for us, except down the valley. At the same time it was undeniable that the village was very empty, and many familiar faces were away. We were told that many had gone off to the Lohit.

The maize was growing tall now and would be ripe in a month. Beans were available, nothing else; the barley had been reaped at the end of May. Women and children were busy in the fields, weeding. It was rarely that we could buy even a small fowl; the Mishmis keep them for special purposes, eating the liver, the heart, or some other part to cure certain sickness. For the same reason they would only sell us eggs which the hens had failed to hatch.

As the Mishmis refused to take us back to our old camp or up the valley again, we went a day's march downstream to Meiliang on July 22. The day was fine and fiercely hot, and we found the march along the overgrown path extraordinarily trying. The Meiliang *gam* received us with mixed feelings, and was warned by the truculent Peti Mishmis not to bring us back unless he wanted his village burnt to the ground. Meanwhile we had to send urgent messages to Sadiya for more rations and supplies. Nearly five weeks passed before the coolies turned up, by which time we had been on short rations for some time,

and were getting rather desperate. We spent three weeks in the hot sticky valley before we could prevail on the *gam* of Meiliang to take us up another ridge on the way to the peak called Polon, above our camp. Luckily for us, Meiliang, like Peti, do not hunt, Polon being the special preserve of another smaller village. These people protested furiously, but by that time we were established on the ridge once more, and the rage of the hunting Mishmis, always in a minority, was impotent to move us.

We moved up into our new camp on August 17, and encountered regular drought conditions from the start, although it had rained heavily and continuously earlier in the month. Our altitude now was not more than 9000 feet, and we were dependent for several days on a small muddy pool in the bamboo forest. How this had been formed it was impossible to say—it looked like an elephant pool. When this water was finished we found a spring of clear water some distance away, and on September 3 the monsoon definitely started again.

Our first concern now was to reach the alpine region, rediscover all the flowers we had found on Kaso (and any others we could), and if possible make our way along the Dou–Delei divide to Kaso. Once we reached Polon the actual distance along the crest of the ridge was not more than 7 or 8 miles; but we soon found that it was much more difficult to reach Polon than it had been to reach Kaso. The path was not continuous, and the ridge was more undulating. The fine weather was spent in clearing a continuous path through the thick Rhododendron growth; after that the peak was obscured, and we could never be sure that we were on the right ridge. Not till the end of September did we at last reach the alpine region and the base of the final peak.

We were interested to observe some ordinary pit traps in this part of the forest. The Mishmis said they were for deer, but it seemed unlikely that any deer would have been heavy enough to fall through the solid bamboo grating laid across the top of the large but rather shallow hole.

At the beginning of October the weather changed for the worse and a violent wind blew first from the north, then from the south. After a week of heavy rain and a drop in temperature it began to snow in the alps, and eventually, owing to the weather, to lack of food and to the uncompromising attitude of the Mishmis, we were driven down to the valley again on October 15, without having made a tour of the ridge from Polon to Kaso, as we had hoped to do. This was now impossible. There was deep snow above 12,000 feet, and in such weather we could not have found the way; our experiences on Polon had taught us the futility of it until the weather cleared. Help from the Mishmis was now out of the question, as they had no adequate protection against the cold.

The 16th was fine, and on the 17th, accompanied by two Mishmis, I went up the valley to Abogam. The following day the storm continued, but on the 19th we went up Kaso ridge, spending that night in the cave at 11,000 feet; snow was falling here the next morning. I spent that day alone on Kaso, getting to about 13,000 feet, where the snow lay knee-deep and almost everything was buried; however, I managed to collect seed of everything that mattered, and returned at dusk to the lower cave at 10,000 feet, where we spent a more comfortable night.

The weather then cleared and kept fine for four days. Having rejoined Clutterbuck in the valley, we packed up and started down the valley on the

22nd, Clutterbuck making direct for Denning with the kit, while I, with two Mishmis, made a final assault on Polon. We reached the cave (11,000 feet) the following afternoon, and on the 24th climbed Polon just as the weather broke up again. There was a lot of snow, but not as much as there was on Kaso, and I was able to gather seed of several plants missed on the first expedition. Near the top we were caught in a bad snowstorm, and we got back to the cave late in the afternoon with no hope of another chance. Next morning the whole mountain was hidden in mist and snow, and nothing more could be done, so we started down for the last time. By forced marches we reached the Lohit the following night, and actually marched into Theronliang bungalow two hours after Clutterbuck, who with thirty-five coolies under his charge had made single stages, on the evening of October 28. Denning was reached on the 30th, and Sadiya on November 1. Not only did it rain almost the whole way, which of course meant snow in the hills, but even in Sadiya the weather did not clear up till the middle of November. When the Mishmi Hills were again visible from the plains they were finally and utterly snowbound for seven months.

The chief results of the two expeditions were of course botanical. Apart from the discovery of about a hundred new species of plants, the most interesting discoveries were those of Sikkim plants found far to the east of their original habitats, e.g. *Meconopsis paniculata*, *Primula Wattii*, *Bryocarpum himalayense* and *Rhododendron lanatum*, to mention only a few; and of Chinese plants far to the west of their original habitats, e.g. *Primula vernicosa*, *Viola pogonantha*, *Polygala Mariesii*, *Trollius Farreri*, and many others. It is now possible to define with more accuracy than hitherto the limits of the several floral regions which meet in this area, and to state with some assurance that there are two distinct alpine floral belts, northern (Sino-Himalayan) and southern (Indo-Himalayan), which extend east and west independently of the apparent north–south trending Burma–Yunnan ranges.

Amongst the new plants discovered are twelve species of Primula, 18 Rhododendrons, a Michelia, a Callianthemum, a Stauntonia, a Holboellia, a Clematis, a Mahonia, three species of Meconopsis, an Androsace, six species of Saxifraga, a Gentian, a Paris, a Ypsilandra, a Blumea, a Buddleia, and others.

Various new insects, including two interesting grasshoppers (*Podisma kingdoni* and *P. assama*) and a new ground beetle (*Haplogaster wardi*), were collected, and a remarkable Trogon (*Ptyrotrogon wardi*).*

The purely geographical results, beyond the exploration of the Di Chu valley, were perhaps more promising for the future than of immediate importance; the observations on ice action on the Irrawaddy–Lohit divide have been referred to.

The herbarium specimens were presented to Kew, and through the generosity of Mr. de Rothschild, both Kew and Edinburgh received shares of seeds, amounting to some two hundred species.

The insects, Trogon, and a collection of small mammals were presented to the Natural History Museum.

*Male and female specimens of this bird were collected in Northern Tongking by M. Delacour in 1928.

DISCUSSION

Before the paper the PRESIDENT (Colonel Sir CHARLES CLOSE) said: At our last evening meeting in this hall, a fortnight ago, H.R.H. the Duke of Spoleto gave us a most admirable account of the results of the Italian Expedition to the Karakoram, at the western end of the great mountain barrier which protects India from the north. To-night we must travel in imagination for 1500 miles to the extreme east of that barrier range, to the mysterious and difficult country to the north of Burma and the north-east of Assam. It is a country which is peculiarly interesting to geographers because it is in that neighbourhood that five great rivers are bunched together, as it were. We have the Yangtze, the Mekong, the Salween, the Irrawaddy with its two branches, and the Brahmaputra at its great bend. Those five great rivers are there within a comparatively short distance of one another; indeed, a stretch of 230 miles would include all five. I do not suppose there is a similar phenomenon anywhere else on the Earth's surface. This region is one which is well known to our lecturer to-night. Mr. Kingdon Ward has travelled in Western China, in Northern Burma, in North-East Assam and in Southern Tibet—in fact, in the whole of the region, and there cannot be many travellers who know so much about that remarkable eastern end of the great mountain barrier of India.

Mr. Kingdon Ward is well known to us for his explorations and botanical researches. He has lectured to us before. He has contributed several papers to our *Journal*, and he has twice received the Cuthbert Peak Grant, which is given with a general desire for more favours; that is to say, we give it as a rule to those explorers who, we hope, will do something more. In each case he has justified our award.

I will ask him now to describe the journeys which he undertook in 1926 and 1928 in that remarkable region.

Mr. F. Kingdon Ward then delivered his lecture, and a discussion followed.

Colonel BAILEY: I should like to say one word about the Mishmis among whom Mr. Kingdon Ward has been travelling. I came in upon them from the north, that is to say, from China and from Tibet, and I heard rumours about them from the Chinese. The first thing the Chinese told me was that these people had tails. I could hardly believe it, though they said that it was perfectly true. But the nearer I got to the Mishmis the shorter grew their tails, until they came to be only about 3 inches long. The Chinese said that the Mishmi was very much ashamed of his tail, and that I should notice that his coat was always just long enough to cover it. He would never let you see it, and when he sat down or walked about he always kept that part of him covered so that you should not see his tail. His tail was stiff, and when he sat down he had to make a hole in the ground with a stick to accommodate it. I discovered that the real explanation was that the Mishmis have to carry loads on their backs, and they have a T-shaped stick on which the load is rested. When they rest the stick naturally sinks into the muddy ground, and so wherever these people have been resting you find little holes in the ground.

Mr. Kingdon Ward said that the Mishmis have no very unpleasant practices. I had something to do with those in the next valley, that is the Dibang, farther to the west, and they are rather an uncertain people, I think. One of their customs, we found, was this: If a man died, any old, lame, or crippled women were put alive into his grave. An old man was always safe; but an old woman, a crippled or lame girl was put into the grave alive with the dead man. As far as I know, that is going on to the present day. We once saw a girl being taken away, but we had no idea what it meant. It was on the other side of an impassable river. We did not

know what had happened to her until we were told five or six days afterwards. On the other hand, any man can take such people over and be responsible for them; that is to say, when a man dies another man can say, "I do not want to see this girl buried; I will take her into my house," and she goes. But when the second man dies she is buried unless some one else takes pity on her.

As I have said, I came in upon the Mishmis from the north. I had a very small party—myself and one servant—and I had nothing of any kind about me to show that I was a person of importance. So I had very great difficulty with them. I am quite certain that Mr. Kingdon Ward also had great difficulty, which he has rather glossed over. He has told us of some of his other difficulties, but I am certain that he must have had great trouble with these people, though he has not told us very much about it.

He said something about the cane bridges, and mentioned that the Burmese Government had made them passable for animals. I found in Bhutan, when travelling there with Captain Morshead, that the Bhutanese had done the same thing. It sounds impossible, but they can get a loaded animal over a bridge made of cane. What the Bhutanese did was to put a piece of bamboo matting in the middle of the cane and strew grass and earth and anything of the sort upon it, and loaded mules were taken over the bridge regularly. I see that in Burma they make much more of a platform and put two rows of bamboos down as a footway. When I was in Bhutan and was told that I could get my animals over one of these bridges, I did not believe it, but in the end I found it was possible.

In conclusion, I think we must congratulate Mr. Kingdon Ward on his lecture and on the little he has made of his difficulties with these very uncertain people, the Mishmis.

Mr. BARNARD: I fear that I have very little to add to what Mr. Kingdon Ward has said. I know part of the country. I have been up the Seinghkuwang and over some of its bridges. As Mr. Kingdon Ward said, it is possible to take laden mules across them. I have seen mules fall through a bridge. Sometimes one will fall through, with three legs on the bridge and one between the canes, and it is marvellous how a Chinese muleteer is able to get the animal up with a load of 120 lbs. on its back.

Mr. Kingdon Ward mentioned the Tibetans in the Seinghkuwang, but he said very little about their smell. I have had occasion to meet Nagas, and they are pretty bad, but not so bad as the Tibetans. From their big grey coats they produce the most marvellous things. Out of his coat a man will produce a gun, a roll of cloth, a bamboo pot full of ghee, which is the butter they make—it is rancid stuff and smells terribly—and so on.

I followed the lecture with very great interest. I was taken back to a country that I shall never see again, in all probability. I spent the greater part of my life on the frontiers of Burma, and it has been extremely pleasant to listen to Mr. Kingdon Ward's experiences.

The PRESIDENT: Before thanking Mr. Kingdon Ward for his lecture I should like to make a slight correction with regard to something that he said. He talked about India and China having each from 200,000,000 to 300,000,000 people. I think I am right in saying that India has a population of something like 330,000,000 and China of probably over 400,000,000. So he understated his facts—a custom which might be followed by other lecturers.

We are grateful to those who made this expedition possible. I would mention particularly Mr. Lionel de Rothschild, the Percy Sladen Trustees, and the Government Grant Committee of the Royal Society, who contributed the funds. Mr. Kingdon Ward's expedition will remind some of us of those earlier expeditions made by Sir Joseph Hooker some eighty years ago, not very far from this

part of the world—that is to say, in Sikkim. He also talked of the trouble he had with the bridges. He mentions quite feelingly the difficulty of getting across the various cane structures he met with. He too, as we know, was a great botanist and explorer.

While I mention that, I should say that Mr. Kingdon Ward has been very modest about his acquirements as a topographer. He knows a great deal more about topography and the method of making a map than he will admit. But, after all, geography is essentially a description of this earth. It does not entirely consist in making maps, and the lecture we have heard this evening is a very good example of what geography is. It has brought before us accurately and clearly a part of the world of which we should know very little were it not for the labours and experiences undergone by explorers like Mr. Kingdon Ward. We are grateful to him for what he has told us to-night.

I gathered from him, incidentally, that England is covered with Blue Poppies. That only shows how very unobservant one may be. I personally have not seen one yet, but that only indicates that one must keep one's eyes open. I am glad that he mentioned the old road made by the Bengal Sappers in the Mishmi Expedition of 1912. We are all grateful to Mr. Kingdon Ward for his lecture, and in the name of the Society I beg to thank him.

EXPLORATIONS IN BAFFIN ISLAND

J. DEWEY SOPER

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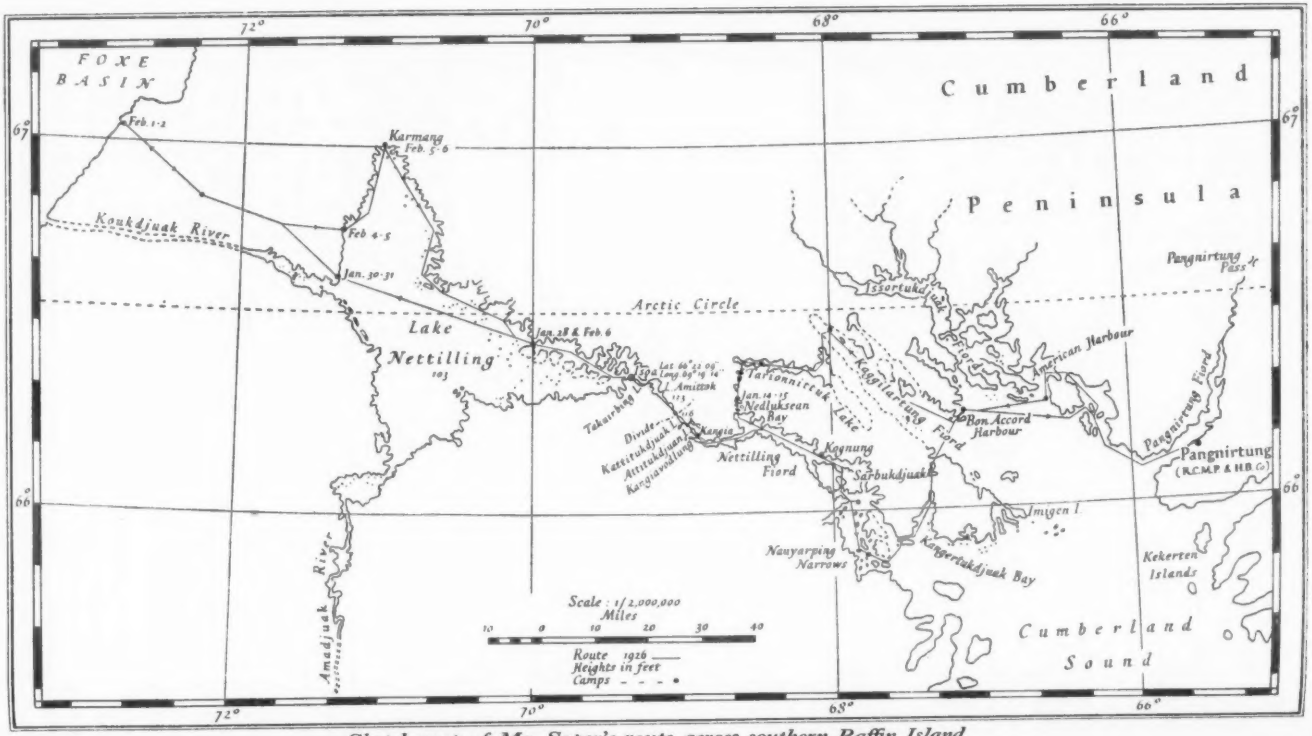
FOLLOWING the Canadian Arctic Expedition of 1923, on which I served as Naturalist in the interests of the National Museum of Canada, I returned north in the summer of 1924 to devote two years to investigations in southern Baffin Island. The previous expedition had not only provided an opportunity for collecting valuable northern material, and for obtaining a personal knowledge of conditions in Ellesmere, Devon, and Baffin Islands, but also served as a reconnaissance of the merits of various regions for future more serious work. This led to the choice of southern Baffin Island, largely because its interior was unknown. So headquarters were made in July 1924 at Pangnirtung Fiord, Cumberland Sound, where posts of the Royal Canadian Mounted Police and Hudson's Bay Company had already been established some time before.

While my primary object was biological, I went prepared to travel widely and make simple surveys. For several months of each year, therefore, the work was chiefly of geographical interest. The principal object of the present paper is to describe briefly a crossing of Baffin Island from Pangnirtung to Foxe Basin in January and February 1926.

The summer and fall of 1924 were devoted largely to natural history investigations in Cumberland Sound, from Pangnirtung, Issortukdjuak Fiord, and the Kekerten Islands, south-eastward to Blacklead Island and Bear Sound. After the close of navigation in early October, active preparations were made for extensive travelling by dog team during the winter months to follow. The first



Sketch-map of Mr. Soper's route across southern Baffin Island

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of these trips had for its object a crossing of Baffin Island from the head of Issortukdjuak Fiord *via* the large unknown lake, Tesseokjuak, reported by the Eskimo to lie north of lake Nettilling; thence it was planned to follow the Hantzsch river,* assumed to drain this lake, down to Foxe Basin. Though a total distance of nearly 400 miles was covered in making this attempt in January 1925, it ended in failure, owing to deep snow and shortage of dog feed, arising partially from complications suffered upon entering a deep *cul de sac* in the mountains north-west of Issortukdjuak Fiord.

During February and March 1925 a journey of exploration was made from Pangnirtung through Pangnirtung Pass, in the Cumberland mountains, and north-west to Kivitoo, immediately south of Brodie Bay in about latitude 68° N. The return trip was by way of Merchants Bay and Kingnait Pass to Pangnirtung, the entire journey covering about 600 miles.

On April 22 I left headquarters to conduct biological and exploratory work about the little-known Nettilling Lake region in the interior west of Cumberland Sound. With the aid of a party of Eskimo and seventy dogs, a large boat and supplies for five months were hauled with great labour to the eastern extremity of lake Nettilling, where a main camp was established on May 5 at Isoa at the mouth of the Takuirbing river. Heavy ice in the lake prevented its exploration until mid-August, when a start was made in the sail-boat for the southern extremity. Here the Amadjuak river was explored for some little distance, when the voyage was continued up the west shore of Nettilling Lake to, and down, the Koukdjuak river for about 10 miles. Our original intention had been to descend this great river to Foxe Basin and thus complete a crossing of Baffin Island; but, the season being already late and supplies short, we returned to Nettilling Fiord and finally to Pangnirtung, which we reached on September 21 after an absence of five months.

This second failure to cross the island in 1925 led to plans for its achievement during the winter of 1925–1926. Up to this time only one white man had ever succeeded in crossing Baffin Island from east to west: an honour which falls to Bernhard Adolph Hantzsch, a German naturalist of Dresden. Unfortunately, Hantzsch perished on the west coast in June 1911, where he was buried by his Eskimo companions about 12 miles north of the river which now bears his name. At the time of my residence at Pangnirtung, while broadly familiar with the circumstances of his tragic end from reports of the Cumberland Sound Eskimo, I was unaware that any important records of his trip had reached the outside world. But, in fact, his field notes and natural history material were brought out of the interior by the Eskimo of his party and finally reached the Royal Zoological Museum in Berlin. The results of his work have been published in German, and recently made available on this continent through a translation by M. B. A. Anderson, M.A., and R. M. Anderson, PH.D., of Ottawa.

I had become increasingly convinced, from native statements and other considerations, that the west coast of Baffin Island lay considerably farther east than indicated on maps of the period, and to decide this was one of the most

*This river, reported to me by the Eskimo in 1924, and known to them as Koukdjatariak, I have since visited and surveyed for a distance of 39 miles from the mouth, which lies in latitude 67° 33′ 30″ N. The name Hantzsch River has since been proposed, and passed by the Geographic Board of Canada.

Sketch-map of Mr. Soper's route across southern Baffin Island

interesting features of the proposed undertaking. Again, it was my object, after making the traverse of the island, to complete the survey of Nettilling Lake by following the north shore on the return trip; for lack of time only the southern portion had been established during the summer of 1925. Lastly, the journey would provide an intimate knowledge of the mid-winter game conditions from one side of the island to the other.

It was generally understood from Eskimo report that the western portion of Baffin Island has no game during the winter, and is a pitfall for travellers without proper supplies. Personally, I had no profound faith in an interior region that would provide sustenance, whenever one most required it, by allowing one to "live off the country." Contrary to the opinion which seems to be held here and there, large "blanks" exist in the Arctic where no game at all occurs, or at best it is extremely scarce. In any of these a party might easily meet death by actual starvation, as Eskimo have already done time and again.

We left Pangnirtung on the morning of 9 January 1926: with Akatugak (my regular assistant), Newkeguak, Poojut, Kunalusik, and three teams of fourteen dogs each. According to my plans, after a ton of seal meat had been suitably put up at the northernmost tide-rips, or *sarbuks*, in Nettilling Fiord, and a large cache had been established at Isoa on the eastern end of Nettilling Lake, Poojut and Kunalusik were to return to headquarters, while the remainder of the party was to continue on to Foxe Basin.

When leaving Pangnirtung the sledges carried comparatively light loads, as no dog feed was carried, and for much of our own food we depended upon supplies left over from the expedition of the year before and cached at Isoa. Taking advantage of this, we decided to explore a new route which was thought possible between Kaggilartung fiord, *via* Tarionnittuk Lake and a point in Nettilling Fiord. This would bring a region under observation which, so far as records show, had not previously been visited by a white man, instead of our following the well-known route by way of Imigen.

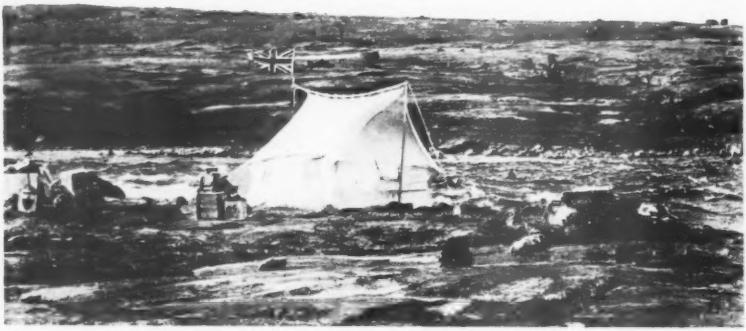
The night of January 9 was spent at American Harbour. After a difficult day in heavily rafted ice, Bon Accord was reached the next night, where quarters were found in an Eskimo village. No seals could be had the night before at American Harbour, so the dogs went hungry for two days. On the 11th I ordered a hunt to a near-by *sarbuk*, not only to rest and feed the dogs well, but to get a few seals to feed them on the land crossing to Nettilling Fiord. This hunt was highly successful, so on the 12th we started up Kaggilartung with enough meat, it was thought, to last the dogs until the Kognung "sealing holes" could be reached in Nettilling Fiord. The night camp was 30 miles up Kaggilartung, opposite a deep valley which the natives asserted was the only possible route to Tarionnittuk Lake.

In the morning this valley was tried and found rather difficult, with a rapid rise of 300 feet and numerous ice-falls up which the sledges were hauled one by one, by hitching all dogs to the single bridle. Once up this seaward-facing slope the route was easier, through a narrow valley flanked by sheer walls of granite 300 feet high. Two miles inland the valley terminates abruptly in a chaos of massive boulders at 350 feet, beyond which there is a breath-taking descent of about 340 feet to the surface of Tarionnittuk Lake. The sledges were shot down one by one after removing the teams, while the party clung desperately

Looking north up Pangnirtung Fiord, late August 1924

Mountains of Cumberland Peninsula, west side of Pangnirtung Fiord, September 1924

Topography round Lake Takuirbing immediately east of Isoa, looking north, August 1925



Camp at Isoa near mouth of Takuirbing river, eastern end of Lake Nettilling, summer 1925

Rapids on Takuirbing river between Lake Takuirbing and Lake Nettilling, July 1925

to the lash ropes and used feet as drags in the snow to reduce the momentum. During the afternoon the north-west coast was followed almost to the extremity of a narrow bay trending in that direction. The cold was very severe at this period, with a light breeze at −45° F., and it became colder as progress was made into the interior; all our faces suffered more or less frost-bite during the run.

Tarionnittuk is said by the Eskimo to lie practically at sea-level and at spring tides to receive a relatively small amount of salt water through a narrow canyon occupied by a river which discharges at its southern end. The Eskimo were definite in their assertion that the freshness of the lake was in no way impaired by these occasional tides, except near the head of the canyon. In order to verify this statement, at least partly, a hole was sunk through the ice near the north-western end of the lake, where the water was found to be perfectly fresh. The ice, incidentally, was 30 inches thick at this time.

On January 14 we continued 5 miles up the bay, when we turned southward through a narrow valley into a neighbouring lake. The entire day was spent in travelling south over small lakes and up connecting streams, in many instances through loose powdery snow from 1 to 2 feet deep, which demanded the exertions of the entire party in addition to the dogs. Near nightfall the height of land was passed at about 600 feet above sea-level, and a rapid descent almost immediately made to a small lake 300 feet below. The outlet passed through a deep, dark canyon where the ice had already accumulated to an enormous thickness, owing to the streams' continual overflow and consolidation. As the ice-falls were particularly dangerous here, the dogs were removed and the sledges lowered by lines and rope drags. Snow houses were built for the night a short distance beyond on the border of a picturesque tarn surrounded by Pre-Cambrian crystallines of excessive ruggedness.

Next day we had some difficulty in finding a route to the south, but finally discovered a narrow valley with a creek which gave access to a chain of small lakes leading in the desired direction. At noon the party emerged from the hills and found itself confronted by a large salt-water bay, which the Eskimo presently identified as Nedluksean, in the upper part of Nettilling Fiord. Thus conveniently ended the traverse between the two large fiords, during which twelve lakes were crossed and a sound conception gained of the intervening and hitherto unmapped region. Travelling south-east for 12 miles through a thick blizzard, the party finally reached the Kognung tide-rip, where sealing operations were to begin, and there threw up a temporary snow camp. No hunting was possible that night, and the dogs again went foodless for a third day, as no game whatever had been seen after leaving Bon Accord.

On January 17 we moved to a more advantageous position as regards the sealing hole, and there built a large snow igloo 14 feet in diameter and 9 feet high, with an elevated sleeping platform sufficiently large for the entire party. Here we expected to wait a week or ten days, shooting seals and preparing the meat for the inland work, so the camp was made as convenient as possible, and with plenty of blubber for the stone lamps, or *kudliks*, it was rendered quite comfortable, despite some 70° of frost. Above all, however, there were ample facilities for drying wet clothes after the day's work—an inestimable advantage in all phases of winter work in the Arctic.

It is not necessary to dwell here on the various details of the seal hunt at this time, the success of which was absolutely essential to the traverse of Nettilling Lake and the gameless western tundra beyond. I need not emphasize the difficulties of hunting day after day on the edge of the tide-holes at this season, in the bitter winds, and the whole trying business of skinning, chopping up, freezing, and bagging the meat in preparation for the start. When the Kognung *sarbuk* began to fail, others were visited from 10 to 15 miles to the east and south-east, including even that of Kassigidjen and the lower end of Sarbukdjuak. After a steady week of more or less disheartening work, success still hung in the balance. Then on January 23 came a turn in our fortunes when nine seals were shot in quick succession at a small tide-hole near Missertung. With seals relatively scarce, it was a severe struggle to get ahead as in addition to acquiring the minimum amount of meat required inland, forty-two hungry dogs had meanwhile to be supported; on more than one day all our hunt went to provide the evening meal.

Finally, after nine days of ceaseless effort and alternating hope and doubt, about 1600 pounds of meat had been accumulated, and with this it was decided to make a start. The full moon was near at hand, and with the short grey days of January as a definite handicap, all were anxious to take advantage of its light for the crossing of the interior. On the morning of January 22, therefore, the party started westward, into a blistering head wind at −32° F. Nothing is more tiresome or exhausting; the dogs drive hard, and with heavy loads at such low temperatures progress is necessarily slow. Two of the dogs had recently died, and this proved a further handicap. Kangia was reached in late afternoon, at the head of Nettilling Fiord, and camp made for the night by the light of a brilliant moon.

January 26 was absolutely cloudless with the mercury at −45° F. While ascending the long icy slope to Kattituakdjung Lake, the low sun presented a beautiful spectacle. It seemed to be expanded in a bright glare of intensely white light and was surrounded by a large luminous circle tinted with pale red. From the centre ran four radii coincident with the vertical and horizontal diameters of the circle, where, at their intersections with the latter, were four brilliant parhelia vivid with prismatic colours. In addition to these were four bright arcs intersecting the parhelia on the outer rim of the great circle.

The five lakes constituting the route from Nettilling Fiord to Nettilling Lake —Attitukdjuan, Kattituakdjung, Kattitukdjuak, Amittok and Takuirbing— were successively crossed, and Isoa, at Nettilling Lake, reached by 3.50 p.m. The highest lake on the route is Amittok, 123 feet above sea-level, while Nettilling lies at 103 feet. Both the Amittok and Takuirbing rivers were still partially open, notwithstanding the low temperature of many previous weeks.

A day was spent on the site of our old camp of 1925 to make a few necessary arrangements. On the morning of the 28th the party divided, according to pre-arranged plan, after establishing a cache of dog feed against our return from the west. We were now in the land of low hills and benefited, accordingly, by the earliest light. The whole path of the sun, now above the horizon for about five and a half hours, was visible in this land of low relief, and afforded a radical change from the gloomy mountain valleys to the east.

After tracing the north shore of Nettilling Lake for a day, a course was then

followed about due magnetic north (N. 60° W.) across the lake, the western shore of which was reached in a dense rime-fog on the afternoon of January 30. The coast bordering the tundra at this point is very flat, with here and there low gravel ridges thrown up by ice pressure. Except where this coastal ridge appeared it was impossible, without employing a harpoon-shaft as a probe, to tell where lake ended and the tundra began. At wide intervals, however, grass stalks and the tops of drift boulders protruded above the snow of the tundra, the only point of difference between the latter and the level expanse of the lake.

The morning of the 31st was still thickly misty with frost haze as we proceeded to the north-west. The light falling with even diffusion over this strange low land was exceptionally weird and deceiving and incessantly created mystifying effects in the frosty atmosphere. After a time the rime cleared away, giving place to brilliant sunshine, accompanied by mirage with strange fantasies over the boundless snow desert. The natives frequently expressed their astonishment in this vast unchanging world by exclaiming to each other that all was the same as Lake Nettilling—"*Netchelik to ma*," for neither of them had before witnessed the western tundra in its mantle of snow.

By mid-afternoon we reached the southern outskirt of a low limestone plateau, which rises in places almost imperceptibly from the tundra. Here and there streams have gouged the formation into shallow valleys, while the whole surface is littered deep with angular limestone rubble, and is wholly destitute of plant cover. We skirted the formation to the north-west, and at nightfall made camp on the plain near by.

The following morning was again clear, with the mercury, as for the past two mornings, in the bulb. As the dogs were failing rapidly with the strain of the intense cold and heavy loads, we decided to continue west from this camp with only sufficient supplies for four or five days and thus lighten the loads. We estimated that after one day's travel west of Nettilling, our position could not be more than two days from Foxe Basin, even though the old maps were correct. Accordingly the igloo here was used as a depot for all surplus supplies, to be recovered on the return march. We took the precaution to fly a Union Jack from a short mast on the snow house and to leave trails for a quarter of a mile on each side north and south of the depot, to facilitate its location in case of thick weather.

The day's march westward was a repetition of the last—a steady grind, hour by hour, through a dead encircling world of snow unrelieved by sign of living creature, except at rare intervals the solitary trail of an Arctic fox, or lemming. As during the past three days, the mercury remained doggedly in the bulb. The curious aspect of our surroundings called for many a comment; over all hung a strange sense of unreality. The deceptive circle of the horizon merged the level plain and the lower sky into a frosty similitude of mystic light which moved onward and closed behind us imperceptibly with no sign of change.

In a firm belief of a more easterly disposition of the west coast than was shown on existing maps, I had anticipated our arrival at Foxe Basin on the night of February 1. But though we marched on until late afternoon under a brilliant moon, no sign of it was seen. Before dark, however, a dusky mass of vapour was observed hanging over the western horizon, which proved the presence of open water in Foxe Basin. We knew that the coast could not be far off.

The next day was also cloudless and calm, with a degree of cold that my party had never experienced the winter before. Upon emerging from the igloo at 8.30 a.m. a long jagged line of white spread along the horizon to the west. The sun had just cleared the flat skyline to the south-east, bringing this stratum into startling relief, upon which the mirage had begun to play. This was recognized at once as the rough ice of the long-sought shore; at last Foxe Basin had been sighted, and half of the trek was over. We spent the day in travelling northward on the plain along the margin of the grounded pack-ice, returning to the old igloo for the night.

Without particular event we reached Nettilling Lake two days later, on February 4, after having recovered the supplies at the plains depot en route. The dogs showed the strain of the trip by being listless and hard to drive. The intensity of the cold rendered the snow grit-like, and the best treatment of the runners with blood and ice seemed to ease very little the burden of the draught. Nor were we ourselves exempt from long marches and frequent hauling on the ropes. An entry in the day journal at this time reads: "The whole day has been an unceasing battle with the piercing cold, which is positively punishing in its intensity—quite unlike the average cold of the sea-coast around Cumberland Sound. The dog harness is frozen hard even in use, while the seal-line traces are brittle and often break when kinked, a thing seldom seen in the more humid atmosphere of the eastern coastal regions."

A long march north along the west coast of Nettilling Lake brought us, on the evening of February 5, to the northern extremity of the lake, known to the Eskimo as Karmang. Many generations ago it was a favourite resort for the Eskimo hunting the caribou during the summer over the rolling uplands to the west and north-west. Here the boats were hauled up, and camps pitched where the women and children remained to spend happy days in July, while the men roamed far and wide to secure caribou skins for winter clothing.

The line of contact between the Palaeozoic limestone and shales of the west and the Pre-Cambrian crystallines of the east occurs at Karmang. The former rises in gently rounded hills to 200–350 feet, while the granites to the east seldom exceed about 250 feet above lake-level. Had I been able to procure caribou here I intended to cross over from Karmang to Foxe Basin for the second time, so as to secure further details of that coast and establish its distance from the north end of Nettilling Lake. But while a few caribou trails were seen in the low granite hills in the neighbourhood—the first since leaving Nettilling Fiord—they were old, and extensive hunting by every member of the party failed to discover any of the animals. The project was therefore abandoned.

On the forenoon of February 6, after building a cairn and depositing a record, the journey was resumed down the north-east coast of the lake. Two days later the survey was tied in with the last point of contact on the north shore of Nettilling Lake, at our outbound camp of January 28. A forced march the following day brought us safely to Isoa again, to find that a dog which had deserted from Newkeguak's team on January 27 had broken into the meat cache and made away with most of the reserve during the intervening eleven days. In addition, he had destroyed two good caribou skins left behind by the men as reserve bedding. This put things in rather a bad way, as our teams had travelled nearly 300 miles on a three-quarter ration and for the past forty-eight

hours had gone without food of any kind. However, we were forced to camp and let the animals shift for whatever scraps could be found. No living creature had been observed during the two weeks' trek into the west, though a few caribou trails had been seen at Karmang, as already mentioned. We therefore inferred that it was no proper place to linger on the chance of living off the country—not at this season at least.

The dogs were very slow the next day and we got no farther than Kangia, on Nettilling Fiord, where we spent the night. A sharp watch had been kept for game all the way down the lake-chain to the sea, but no sign of life was noted apart from a few trails of hare and ptarmigan along the Amittok River; consequently the dogs were forced to go hungry into the fourth day. On February 10 the run to the Kognung tide-rip was accomplished in five hours, with the mercury up to —15° F. In comparison with the recent experiences in the interior the weather seemed almost spring-like. The animals felt the advantage of it too, with light sledges and easy snow. Inside of an hour upon arrival at the tide-rip, three ringed seals had been killed, and a real feast for the dogs was promptly in full swing, the first since January 25.

A day was spent here to rest and feed our teams, then the trip was resumed down the fiord on February 12. Camp was made that night at the Nauyarping Narrows, where Newkeguak shot and dragged in two more seals before Akatugak and myself had half completed the igloo. It was a good example of efficiency. The next day we crossed the fiord and arrived off Kangertukdjuak bay at 1 p.m. I had decided beforehand to ascend this bay and cross overland to Tornait to explore a new route on the way to Bon Accord. With some little difficulty this was accomplished in slightly more than a day, four small lakes being discovered en route. Soft snow about the height of land proved the greatest obstacle, which demanded the exertions of men and dogs alike, especially on the steeper slopes of the pass. On the afternoon of the 14th we fought our way across Kaggilartung Fiord in a blinding blizzard, a careful use of the compass bringing us safely through to Bon Accord by early evening.

With a timely start the following morning we made straight across the sound to American Harbour, where we had intended to spend the night. Later we determined to push ahead to Pangnirtung in a single day. Ordinarily the run of 45 miles is comparatively simple, but this year the upper sound was made difficult by an almost continuous field of badly broken and rafted ice—the result of late fall gales. We reached American Harbour at 3 p.m., after which we enjoyed the good travelling of the " inside passage " among the islands to the east, and reached Pangnirtung at 7.30 p.m.

The entire trip of nearly 600 miles occupied thirty-eight days, and the results embraced all that was desired. Two new routes had been explored to Nettilling Fiord, the north coast of the big lake had been mapped and thus completed, and the Foxe Basin coast, quite in keeping with my earlier conjectures, was determined as lying approximately 55 miles farther east than provisionally indicated on Low's map of 1905.

HYDRO-ELECTRIC POWER DEVELOPMENT IN NEW ZEALAND

R. OGILVIE BUCHANAN

THE development of hydro-electric power has made considerable progress in New Zealand, especially since the war, during which time the installed horse-power increased from 49,000 in 1919 to 149,000 in 1927. Within the last few months the first stages of two new stations have been put into operation, adding a further 90,000 horse-power. In comparison with the power production of Canada, for example (5·3 million horse-power in 1928), this seems trifling, yet it represents a production of 0·17 horse-power per head of population, which is exceeded by only four countries: Norway, Sweden, Canada and Switzerland. It is, too, a very small fraction of the potential power of New Zealand. Two comprehensive inquiries have been made as to New Zealand's resources in this respect, the first, in 1904, by Mr. P. S. Hay, Government engineer-in-chief, who in his report estimated the total, neglecting sources of under 1000 horse-power, at 3,700,000 horse-power, of which the South Island share was 3,200,000. The second report, by Mr. Evan Parry, chief electrical engineer, appeared in 1918, and according to his estimate, still accepted as authoritative, the total was assessed at 4,870,000 horse-power, of which the South Island accounted for 4,100,000. That represents a potential power of 3 horse-power per head of present population, an allowance greatly in excess of the utmost that is likely to be utilized for a very considerable time to come. The *Electrical World* of New York, January 1923,* estimates water-power wealth by expressing it in terms of potential horse-power per square mile of area, and on this basis ranks New Zealand with 47·8 horse-power per square mile second only to Switzerland with 87·9 horse-power per square mile, and followed by Norway with 44·2, Italy with 31·6, and Sweden with 26·0.

Physical Background

This generous reserve of water-power is obviously a result of the topography and precipitation of the country. In both islands the main topographic feature is a mountain backbone running in a general north-east–south-west direction. In the South Island the backbone is high, especially in the Southern Alps, where the average elevation, about 8000 feet, exceeds the height of the snow-line by a full thousand feet. The range is unbroken except for a few high passes, and in the south rises directly out of the sea. In the northern portion of this island wide branching spurs of the main range, together with a parallel eastern system, occupy practically the full width of the island. Less striking than the Southern Alps and their continuations is the Otago Plateau, an upraised and very deeply dissected peneplain, giving the appearance of a series of north–south ranges, separated by comparatively narrow valleys, and gradually dropping in elevation from about 8000 feet in the north-west to about 2500 feet in the south-east.

The North Island backbone, running from Wellington to East Cape, is less high than that of the South Island, less continuous, and with less of its island to

*Quoted by 'New Zealand Official Year Book,' 1925.

Sketch-map showing Potential Power Sites in New Zealand

The chief sites only are named, with figures for potential horse-power

the east of it. Immediately west of it, and occupying the centre of the island, is the Volcanic Plateau, a great triangular mass, characterized topographically by considerable areas of rather level country crowned here and there by ranges and peaks that rise above the general level of 2500 feet. Smaller elements are the isolated cone of Egmont in the west and the low ridges that lie parallel to the east coast from Cook Strait to Hawke Bay.

In brief, a large proportion of the country is mountainous, and much of the mountain area is high. Only Ruapehu (9175 feet) and Egmont (8260 feet) rise above the snow-line in the North Island, but in the South Island 25 per cent. of the area is above 3000 feet and 1 per cent. is above the snow-line. The low plains are all coastal and of limited extent. River gradients consequently are steep, rapids and waterfalls numerous.

For an appreciation of amount and regularity of water supply the most useful materials are measurements of amounts and variations of river flow and of variations in lake-levels. Such data certainly exist for some of the lakes and rivers, but they have not been published. It remains therefore to consider the precipitation.* The rainfall map indicates the distribution of the average annual rainfall in area, and illustrates at the same time the topographic control of the distribution. It will be noticed that precipitation is heavy: only 13 per cent. approximately of the total area has less than 30 inches per annum, while 17 per cent. has more than 70 inches, and half of that has more than 100 inches. The South Island, with its higher and more continuous mountain ranges, shows a greater contrast between east coast and west coast, and contains the areas both of greatest and of least precipitation of the Dominion. In the North Island the striking feature is the large proportion (87 per cent. approximately of the area of the island) receiving between 40 and 70 inches.

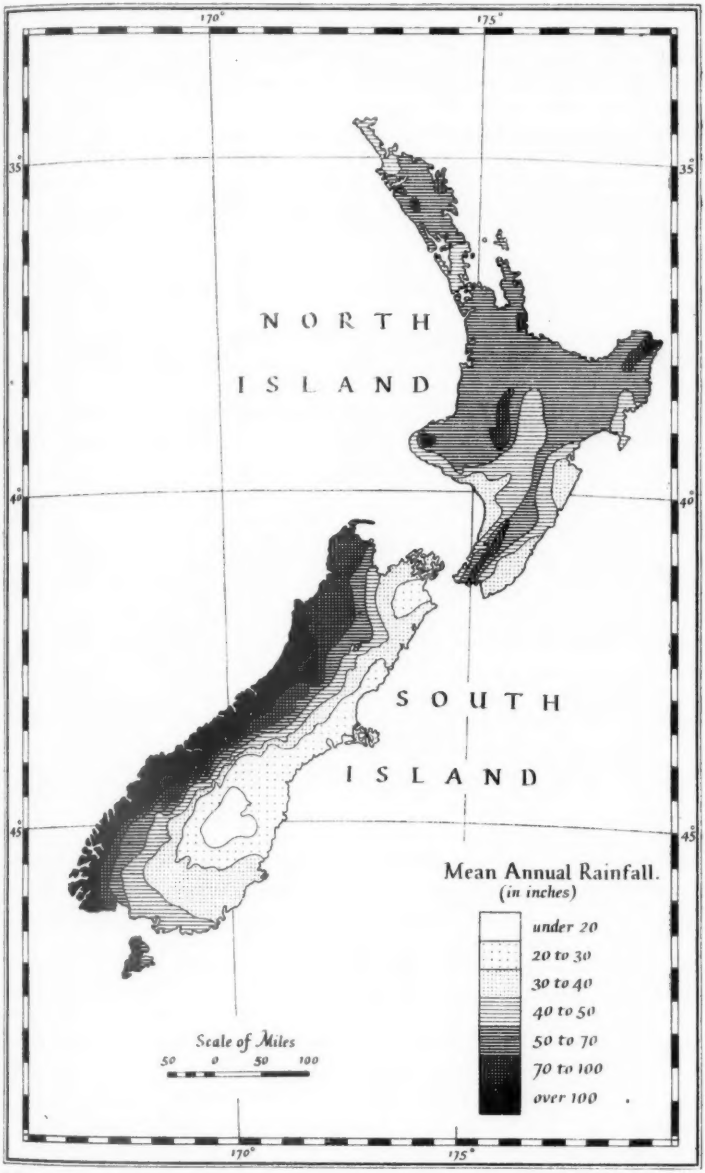
Seasonal distribution is on the whole even (Table I). This is particularly true in the South Island. In the North Island there is characteristically, though not universally, a winter maximum, but even in the far north there is no appearance of the summer drought typical of these latitudes in other parts of the world. At Auckland City, 36° 5′ S., January, the driest month, has an average rainfall of 2·66 inches, and December, with 2·84 inches, is the only other month that drops below 3 inches.

Possibly even more important than seasonal distribution of the rainfall is its reliability, and of this a useful method of assessment is given by an examination of deviations of actual from average monthly rainfalls.† For the eight stations examined the absolute values of the deviations, irrespective of whether they were positive or negative, have been averaged in the ordinary way, and the result for each month expressed as a percentage of the average precipitation for the month in question (Table II).

These results may be summarized as follows: Average monthly deviation percentages range from 21·2 for April at Invercargill to 81·2 for October at Napier. Of the 96 monthly records represented, 25 show percentage deviations

*Climatic statistics from the 'New Zealand Official Year Book' and from 'New Zealand Statistics,' Meteorology Section.

†The stations quoted in this paper are all coastal, but though available records are short there is no reason to doubt that the case for regularity of precipitation in the mountainous areas is even stronger than is here argued.



Map showing distribution of Average Annual Rainfall in New Zealand

TABLE I.—Table of Average Monthly Temperature and Precipitation at Selected Stations.

		Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Year*
Auckland ..	.. °F.	66·5	67·0	64·9	61·2	56·8	53·5	51·7	52·2	54·6	57·2	60·3	63·9	59·1
	Inches	2·67	3·05	3·02	3·43	4·63	4·92	4·95	4·22	3·64	3·69	3·32	2·90	44·44
New Plymouth	.. °F.	61·4	64·6	62·9	59·3	55·3	52·0	50·5	50·8	53·4	55·7	58·3	61·7	57·2
	Inches	4·42	4·00	3·62	4·51	6·23	6·14	6·29	5·33	5·22	5·61	4·65	4·33	60·35
Napier ..	.. °F.	66·1	65·5	63·0	58·7	53·8	50·1	48·9	49·9	53·6	57·5	60·7	64·1	57·7
	Inches	3·14	2·89	3·26	2·87	3·73	3·54	3·87	3·56	2·16	2·29	2·48	2·32	36·11
Wellington ..	.. °F.	62·5	62·5	60·5	57·0	52·7	49·4	47·7	48·6	51·6	54·4	56·9	60·4	55·4
	Inches	3·30	3·19	3·29	3·80	4·76	4·87	5·55	4·43	3·99	4·19	3·44	3·30	48·11
Hokitika ..	.. °F.	60·3	60·6	58·5	54·7	49·9	46·4	44·8	46·3	50·0	52·7	54·9	58·4	53·1
	Inches	9·92	7·37	9·75	9·39	9·82	9·55	8·99	9·28	9·32	11·81	10·78	10·62	116·60
Dunedin ..	.. °F.	58·0	57·7	55·4	51·7	47·1	43·8	42·4	44·0	47·9	51·0	53·3	56·3	50·7
	Inches	3·34	2·75	2·96	2·78	3·26	3·15	2·99	3·14	2·75	3·13	3·28	3·53	37·06
Invercargill	.. °F.	57·2	56·8	54·7	50·8	45·8	42·7	41·4	43·8	48·1	51·3	52·8	55·2	50·0
	Inches	3·97	2·97	3·85	4·34	4·49	3·59	3·24	3·38	3·18	4·44	4·39	4·20	46·04

TABLE II.—Table of Average Percentage Deviations from Average Precipitation at Selected Stations.

	Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Year*
Auckland	53·4	64·7	51·5	56·1	33·3	31·4	34·5	36·5	35·9	39·6	53·7	39·1	11·5
New Plymouth ..	46·1	40·8	60·2	42·3	39·3	48·7	27·2	27·6	30·9	27·3	39·8	43·4	12·3
Napier	54·8	50·2	70·9	45·3	66·8	63·0	45·0	43·0	43·5	81·2	48·8	45·7	23·4
Wellington	46·8	55·0	49·4	47·9	39·5	37·1	33·1	34·2	36·6	41·9	40·9	33·7	14·7
Christchurch	45·4	60·9	55·9	50·3	57·9	43·3	51·9	50·0	58·9	50·3	24·5	54·3	14·2
Hokitika	43·3	37·9	33·8	37·3	24·9	33·9	34·6	39·9	29·7	27·4	30·7	29·6	8·7
Dunedin	38·1	49·1	53·7	42·2	39·0	49·5	57·1	52·5	49·7	54·0	44·0	38·2	15·3
Invercargill	30·5	66·7	48·3	21·2	29·3	36·5	27·5	32·8	38·1	27·9	23·5	23·3	9·0
Valencia (Ireland) ..	28·7	37·8	40·3	37·7	35·9	35·9	37·1	31·4	38·2	29·9	33·6	27·9	10·9

of more than 50 per cent., 44 of less than 40 per cent. Five stations have at least six months in the year with deviations of less than 40 per cent.

These figures may be claimed to indicate a high degree of regularity of rainfall, and to give a strong presumption of regularity of river flow. They are somewhat strengthened by two other circumstances. In the first place, the records disclose on the whole a remarkably even balance between the number of positive and the number of negative deviations. The negative instances are slightly more frequent, ranging from 50·8 per cent. of the total at Dunedin up to 69·6 per cent. at Napier. Under such circumstances extraordinary deviations in either direction are unlikely. The second point is that out of all the months examined for these eight stations, totalling 2568, only three were found in which no rain at all had fallen, one at Auckland, one at Napier, and one at Wellington.

These precipitation conditions go far to account for New Zealand's fortunate position in water-power resources, but other factors have a share in determining the degree of regularity of river flow. The table of climatic statistics given opposite shows that temperatures are moderate, and implies that little reduction of river volume takes place by freezing in the winter or excessive evaporation in the summer. Some winter reduction of volume does, however, occur in those rivers which rise in the glaciers fed by the snowfields of the Southern Alps, though on balance it can scarcely be doubted that such rivers have a more regular régime than those which depend wholly on rain. Lakes, the best natural regulators of river flow, are numerous, and many of them are of considerable size. In this respect, too, the South Island is more richly endowed than the North Island. Finally much of the headwater areas up to elevations of about 5000 feet is forested, and even where the forest has been removed or never existed there is a continuous grass cover which checks run-off and helps to even out the effect of variations in precipitation on river flow. The importance of this filtering action of the vegetation has been demonstrated locally, notably in Hawkes Bay and Poverty Bay, where heavy floods in the low country have been caused by deforestation of steep headwater areas in a vain attempt to establish permanent pastures.

Historical

The early settlers of New Zealand built flour mills driven by water-wheels. With the development of railway transport most of these succumbed to the competition of steam mills situated in the larger centres, but a few still exist. The discovery of gold in 1852 inaugurated a period of water harnessing for "sluicing,"* particularly along the Clutha River in Otago, and as early as 1887 a beginning was made on the production of hydro-electric power, a small plant being installed at Rufton in that year.† During the next twenty years private companies and local authorities established a number of small stations, the most important of which were at the Waipori Falls in Otago (Dunedin City Corporation) and at Horahora on the Waikato River (Waihi Gold-mining Company).

*"Sluicing" was the name given to the process of using powerful jets of water to wash down banks of gold-bearing river gravels preparatory to recovering the gold.

†Kissel: "Electricity in New Zealand" in the *New Zealand Journal of Science and Technology*, February 1928.

Meantime the national government had become alive to the part that hydro-electric power might play in the development of the country, and had passed a series of measures which progressively defined the attitude of the state to the water-power resources.* By 1903 water-power was recognized as a national possession, and its ownership vested in the state, which was given the sole right to develop hydro-electricity *for sale*, with, however, the power to delegate the right. It was not until 1910 that the government proceeded to avail itself of its right. In that year a site was selected at Lake Coleridge in Canterbury for the first government station. Work was commenced the following year, and the station was opened in 1915. The war had delayed progress there and postponed government action elsewhere, but in 1918 came Evan Parry's report, which not only surveyed the water-power resources of the country but also considered the amount and distribution of probable demand, and put forward a scheme for national development. Effect was given to this report by legislation in 1919 and 1920.

Briefly put, the aim is the production by the government of the necessary power at a few large inter-connected stations,† and the retail distribution of current by specially constituted local authorities (Electric Power Boards). Local stations already in existence are incorporated in the scheme, where necessary as auxiliary producers, otherwise as transforming stations. At present there are in existence forty-two power districts, administered by elected power boards, some few of which produce their own power, but most of which purchase current in bulk from government stations.

Carrying through a scheme of this scope obviously involves considerable expenditure of public funds. The policy is to make it "productive expenditure" by charging wholesale and retail prices that will cover interest and sinking fund on the capital outlay. In fact, experience has shown that for the first year or two prices low enough to attract consumers will not cover these charges, but that thereafter, with growing consumption, both profits and reduced prices are generally possible. The explanation lies in the fact that overhead costs are much greater than operating costs, that the bulk of the overhead costs are incurred in the original installation of the generating plant and the reticulation of the consuming areas, and that they increase only slightly with extensions of the undertaking. Prices naturally vary from one part of New Zealand to another, according to the amount of current sold and the capital expenditure that has been necessary to enable that current to be provided, but taking a general average of prices for current over all power districts and for all purposes, a reduction was effected from 1·82 pence per unit in 1920 to 1·58 pence in 1927. It is anticipated that, as consumers increase, further reduction, probably to a general average of less than one penny per unit, will be possible.

*1896 Electric Motive Power Act.
1903 Water Power Act.
1908. Public Works Act, incorporating and modifying the 1903 Water Power Act.
1910. Aid to Water Power Works Act.

†In 1929 the four chief stations in the North Island and the four chief stations in the South Island accounted for 187,000 horse-power out of a total of 239,000.

*Power Developments**

We may now examine in greater detail the scheme adopted by the government to prevent the technical inefficiency and economic waste that would result from overlapping and competing enterprises.

The map shows the proposed electrification of the North Island, based on the three key stations of Mangahao, Waikaremoana and Arapuni (eventual horse-power 24,000, 140,000 and 160,000 respectively). It illustrates, too, the linking up with the main system of the various smaller stations already operating. Of these the most important is on the Waikato River at Horahora (17,000 horse-power), installed by the Waihi Gold-mining Company, but now owned and operated by the government,† and supplying besides the industrial demand of the Waihi mines the urban and rural demand of the rich dairying plains of the Waikato, Piako and Thames rivers. Others are Wairua Falls on the Wairoa River, North Auckland (3250 h.p.), Tauranga (5600 h.p.) and Tariki and New Plymouth in Taranaki (4400 and 5000 h.p. respectively).

Of the main stations, Mangahao is situated on the Wellington West Coast Plains at the foot of the steep western slope of the Tararua Ranges, 15 miles south of Palmerston north. It draws its water from the Mangahao River, which formerly flowed north between two of the ranges of the Tararuas into the Manawatu River, but is now diverted by 2¼ miles of tunnels through the mountains into three-quarters of a mile of pipeline to arrive at the power house with a head of 850 feet. Already up to its full capacity of 24,000 horse-power, Mangahao is supplying current to an area that reaches to Napier in the east, to Wanganui in the west, and to Wellington in the south.

Waikaremoana, east of the main divide and about halfway between East Cape and Southern Hawkes Bay, has an area of 21 square miles and an elevation of 2000 feet above sea-level. Its catchment area, though not large, has an average annual rainfall of more than 70 inches. The peculiarity of the lake is that it has no natural surface outlet, the surplus water escaping by underground channels and reappearing some distance away to form one of the headstreams of the Wairoa River. Harnessing the lake to its ultimate capacity of 140,000 horse-power will involve the stoppage of these channels and the provision of a surface outlet. The first unit, providing 30,000 horse-power, was put into operation in October 1929, and now supplies besides its own immediate thinly populated area the easternmost portion of the Southern Hawkes Bay area previously supplied by Mangahao. Further development will permit still greater assistance to Mangahao as increasing population makes further demands on that already fully taxed station.

The Arapuni Rapids station, which also came into operation in 1929 with 60,000 horse-power, is already the largest in New Zealand, but this is merely the first stage of a planned 160,000 horse-power development. It is situated on the Waikato River a few miles above Horahora, and was selected in preference to any of the other rapids farther up the Waikato River partly for economic reasons and partly for technical reasons associated with the site. At Arapuni the river flowed through a narrow gorge, rather over three-quarters of a mile long and

*See Birks, 'Hydro-electric Power Development in New Zealand.' Wellngton, Govt. Printer, 1925.

†This station was bought by the government in 1919.

Sketch-map showing Government Hydro-electric Power Scheme (after Birks) and Developed Power of chief stations to 31 Dec. 1929

with almost vertical sides. A 150-feet dam at the upper end diverts the river into an old deserted course, from which at the lower end it is led down to the power house at the bottom of the gorge. The head so obtained is 175 feet. Arapuni's market is threefold: first, Auckland City and its environs; secondly, the Waikato–Piako–Hauraki Plains, already growing beyond the capacity of Horahora; and thirdly, the ribbon of settlement along the main trunk railway, and thence through the as yet scantily settled country west of the railway to link up with the local stations operating in Taranaki.

The South Island system, though lacking the beautiful symmetry that the triangular shape of the Volcanic Plateau has given to that of the North Island, is essentially similar in its comprehensiveness and economy. The largest station is at Lake Coleridge, one of the numerous South Island glacial lakes. Development has involved damming the natural outlet (which was at the western end), diverting the Harper River into the lake, and tapping the eastern end by a tunnel whose intake is 12 feet below average lake-level. The power house is situated a mile and a quarter away, and the water reaches it with a head of 480 feet. The main consumption is by Christchurch, 63 miles distant, but reticulation covers the whole of the East Coast Plains from Kaiapoi in the north to Oamaru, beyond the Canterbury boundary, in the south. The rapidity of the increase in demand for electricity may be gauged from the fact that since it was opened in 1915 its capacity has been twice enlarged, till it now stands at 36,000 horse-power, that it is being further enlarged to 46,000 horse-power, and that a new station is being established on the Waitaki River, near Kurow, to take over part of the district at present supplied by Coleridge. Details as to the area to be served by the Kurow station are not available, but presumably on the east coast it will supply from Timaru in the north to Palmerston in the south.

The Waipori Falls station, on the Waipori River, 30 miles from Dunedin, is owned and operated by the Dunedin City Corporation. The main river and some of its tributaries are dammed at the head of a deep narrow gorge, and the water is led by tunnel and pipeline to the power house at the other end. The volume of water is smaller than at most of the stations, but the head of 700 feet that is attained helps to compensate for that. The present capacity of 15,000 horse-power is being enlarged to 25,000 horse-power, to cater for increasing rural demand from as far south as the lower Clutha.

The last link in the present South Island chain is the Southland Electric Power Board's plant on the Waiau River, 66 miles from Invercargill. The water is obtained from Lake Monowai by open canal and pipeline, and arrives at the power house with a head of 180 feet. Since it was opened in 1925 its capacity has been enlarged from 5000 to 8000 horse-power, and is capable of further enlargement to 16,000 horse-power as required.

The small scattered stations in the thinly populated north and west of the island may ultimately be connected with the main part of the scheme in the east and south, but that is a distant prospect.

Economic Aspects

This section is concerned mainly with the extent and character of the market for power, and with such new outlets for power as the presence of cheap power may induce. It should be noted that distribution and density of population are

not necessarily safe guides to the amount of probable demand. Canada, for example, in her wood pulp and paper industries consumes large amounts of power in areas that have no dense concentration of population. Consideration must therefore be given to the character of the demand, and this depends on the nature of the occupations as well as on the distribution of the population.

Population in New Zealand is almost confined to the coastal lowlands, where climate, soil and the isolation of the country have combined to make one or other of the branches of the pastoral industry the chief national occupation.* Broadly, the drier east coast lowlands whose grasslands are associated mainly with sheep rearing may be distinguished from the wetter west coast lowlands (including the Auckland Peninsula), where the original vegetation was forest, and which are now the dominant cattle-rearing areas. Here warm winters and sufficiently moist summers give with fertile soils an all-year growth of grass that will permit very close rural settlement based on dairy farming, and already the North Island west coast plains show a rural population density somewhat greater than other parts of New Zealand.

A further fact of importance is the wide scattering of the chief points of concentration of population. Greater Auckland (202,400), Greater Wellington (126,750), Greater Christchurch (122,000), and Greater Dunedin (83,250) (N.Z. Statistics, *opp. cit.*), with an aggregate of 37 per cent. of the total population, are situated at wide intervals over a distance from Auckland to Dunedin of 850 miles as the crow flies. In only three other urban areas (Wanganui, Palmerston North and Invercargill) is 20,000 exceeded. The basis of these concentrations is essentially commercial: the severe rural specialization, exemplified particularly by the dairy industry of the North Island, and by the fact that 95 per cent. by value of New Zealand's exports are pastoral products, involves very active commerce, both domestic and foreign. Evidence of this may be found in the average value of the foreign trade of the Dominion per head of population for the period 1923–27, which was £70,† by far the highest of any temperate-zone country in the world.

Manufacturing is of quite minor importance even if one includes such elementary operations as the making of butter and cheese and the freezing of meat. These, though they bulk large in the economy of the country, are capable of utilizing only small amounts of power. The smallness of the market and of the labour supply (population, 1 April 1928: 1,453,517)‡ has prevented large-scale organization and the consequent economies that would permit successful competition with the great industrial countries. This disadvantage is increased by the lack of available coal and iron. Lignite and brown coals are widespread and can cater more or less adequately for domestic needs, but high-grade bituminous coals occur in only two small areas on the west coast of the South Island. There transport difficulties are considerable: not until long after Coleridge was in operation was there railway connection with the east coast of the South Island, while shipping suffered from the stormy nature of the west coast and the presence of bars across the mouths of the Buller and the Grey rivers. Iron presents another difficulty. No commercially feasible

*New Zealand Statistics: Population and Buildings. Estimated populations 1927.
†New Zealand Official Year Book.
‡*Ibid.*

method of smelting the rich ironsands of the Taranaki beaches has yet been devised, and the smelting of the high-grade iron ore near Onahaka in Nelson Province is carried on under the same disadvantage of small-scale organization that hampers the manufacturing industries.

Industrial demand, then, in the sense in which it would be understood in the United States, Canada or Sweden, does not at present exist. The cities provide the major part of the demand for power—utilized for tramway systems, for numerous small industrial enterprises (flour mills, boot factories, freezing works, rope works, furniture factories, confectionery works, and so on), and especially for public lighting and domestic purposes. Rural demand, however, forms in New Zealand probably a larger proportion of total demand than in any other country, and of this rural demand the most important element is the purely domestic. It should be mentioned that no statistics exist which enable rural demand to be separated accurately from urban, but the following table gives an indication of the great importance of domestic consumption:

TABLE III. (from N.Z.O.Y.B. 1929).—Horse-power of Waterpower in Use in New Zealand at 31 March 1928

Total.	*Mining*	*Elec. Sup.*	*Flax Mill*	*Saw Mills*	*Flour Mills*	*Dairying*	*Constr. Works*	*Freez. Works*	*Paper Mills*	*Miscellan.*
149,485·75	1603	141,949	279	297·5	287	1242·5	37	1295	450	2045·75

Apart from domestic consumption the purely rural demand is for such purposes as the driving of water-pumps, milking, separating and shearing machinery, and the heating of water for the cleaning of dairy plant. For these purposes electric power has considerable advantages. It is easy to apply, and it can be used in small quantities and for short periods without waste. Further, the power is applied smoothly—an important point where animals are concerned, and one which gives electricity a definite advantage in use over its competitor, the petrol engine. It should be mentioned, too, that from the time it was first available electricity was cheaper than petrol, which, imported in tins from California and Sumatra with high freight and insurance charges, was an expensive source of power.

Population distribution, then, is in New Zealand a sufficiently accurate guide to probable distribution of demand for electric power, and so the immediate necessity in creating a national supply was the installation of adequate stations as close as possible to the population centres of gravity of the lowland areas. In the South Island the selection of Lake Monowai in preference to Lake Manapouri or Lake Te Anau, the neglect of Lakes Hawea and Wanaka, and the acceptance of the Kurow site on the Waitaki River to the exclusion of Lakes Tekapo, Pukaki and Ohau in its upper basin are all perfectly sound on this view. Similarly the greater proximity of Arapuni to the Auckland and Taranaki populations and to the main trunk railway line decisively reinforces the claims of this site as against those of the upper rapids of the Waikato River.

As has been shown, the direct effect of the geography of the Dominion has been to fix the sites of the water-powers, and the indirect effect has been to place between the power sources and the small city centres a relatively large rural population engaged in the main in such forms of exploitation of the land as offer a good market for electric power. It is natural, therefore, that primary

attention in distribution should have been directed to the country districts. In no case since the inauguration of the national scheme has power been transmitted directly to the nearest city before the intervening rural areas were reticulated. Kissel, writing at the beginning of 1928, was of the opinion that though New Zealand stood only sixth in order of average consumption per head, it had "the most fully developed and perfectly organized rural reticulation in the world" (Kissel, *opp. cit.*). It is the rural areas that are most responsible for the rapid increase in consumption in the post-war years, an increase according to the same writer, during the period from 1920 to 1927, of consumers from 10·8 to 20·1 per cent. of the population, and of consumption per head per annum from 148 to 310 units.

It remains to glance at some of the effects of cheap electric power on economic conditions. Naturally, effects on rural industry, especially dairying, are most evident. Particularly in Auckland and Taranaki, the small specialized dairy farm carrying a large herd is characteristic, and here, though the absence of winter hand-feeding of housed animals reduces feeding and labour costs, total costs in a country of high wage rates are apt to be very high if much labour has to be employed for milking. With machines a man assisted by two boys can do the milking that would require about six experienced hand milkers. The rapid spread of the milking machine since electricity became available* has either reduced the labour demand of the farmer, or made more labour available for increasing the yield of the farm per cow and per acre by increasing cultivation of supplementary fodder—a valuable contribution to the efficiency of the national agriculture. In so far as any of the labour force is rendered surplus to demand, it may help to swell the "drift to the cities." Contrary to the opinion of most publicists, this is not, at any rate in countries of predominantly primary production, a feature to be deplored: essentially it is an indication of increasing efficiency of rural production, and therefore of real material progress. But if it is in any measure due to the superior amenities of city life, hydro-electric power by banishing much of the drudgery formerly associated with farm life, especially for the women, should prove a powerful ally of the motor-car, the telephone and the wireless set in tending to check it. In any case, the improvement in living conditions and the reduction in the amount of exhausting physical labour are a sociological effect of prime importance.

It seems unlikely that hydro-electric power will enable New Zealand to become an industrial country. Against the possession of cheap power and of raw materials for certain industries must be set the major problems of an adequate supply of cheap iron and the organization of any industry on a scale large enough to secure all possible manufacturing economies. It would seem impossible under conditions of modern competition from countries already industrialized to repeat in the woollen industry the record established in the cotton industry by Lancashire, which from the beginning depended upon foreign markets rather than upon the home market. For a front rank wood pulp and paper industry there is insufficient raw material, and the only industry that seems to hold out much hope of developing to a size of world importance is the manufacture of artificial nitrate, which the experience of Norway seems to prove has least need of a large and expanding home market. That industry

*Milking Machines in use (N.Z.O.Y.B. 1929): 1919, 7577; 1928, 18,049.

however, while it may use great quantities of power, will absorb altogether inconsiderable amounts of labour.

We may conclude that cheap power solves only one of the problems incidental to making New Zealand a manufacturing country, and by itself cannot affect the transformation. Its chief function in the immediate future would seem to be the increasing of the national efficiency in the various stages of the production of wool, meat and dairy products, and, in the more distant future, with increase of population, in improving transport by the electrification of both the suburban and the trunk railways. If, without altering the fundamental economic organization of the country, it can increase the output per head, and *pari passu* decrease the social cost in terms of labour and hardship, it will have achieved no small result.

DISCUSSION

Before the paper the PRESIDENT (Colonel Sir CHARLES CLOSE) said: This Society has been anxious for some little time to increase the number of contributions to its proceedings that deal with various aspects of human geography, and so we welcome this paper by Mr. Buchanan on hydro-electric power in New Zealand, not only on our own account but because of the intrinsic interest of the subject.

Mr. Buchanan then read the paper printed above, and a discussion followed.

Dr. H. R. MILL: This paper has given me great pleasure by recalling the incidents of a visit which I paid to New Zealand in the year 1914, and many talks I had with the then meteorologist in charge, Mr. D. C. Bates, and with municipal and Government officials on this very question of hydro-electric power. I wish that Mr. Buchanan had placed New Zealand a little more on the world. He treated it from the inside, but the water-power of New Zealand comes from the outside, and I believe that there are indications that a large part of the prosperity that we hope it will bring to New Zealand will also be associated with the world outside.

An interesting fact about the South Island is that it lies straight across the path of the "brave west winds," the northern fringe of the Roaring Forties, which to-day strike upon the western face of the Southern Alps, after having in past geological times cut them into one of the most magnificent systems of deep fiords carrying ocean depths right into the midst of the land. Thus those fiords receive a supply of water from high-level lakes that is probably surpassed in no part of the world, not in Norway itself.

The North Island enjoys totally different climatic conditions, its tip, the Auckland peninsula, running right up into the Trade Winds coming from the opposite direction. Throughout the 1000-mile stretch of the two islands there is that interplay of physical configuration with moving atmospheric currents carrying rain, which impress upon one the extraordinary power of water in the air, first in moulding the surface of the land, then in directing the distribution of vegetation and population and, eventually, affecting the commercial prosperity of the country. That is what makes this question so intensely interesting from the purely geographical point of view.

While New Zealand has been covered with a network for carrying electric power into rural districts—one of the great problems confronting our own country at the present time—the greatest future importance seems to me to lie in the utilizations of water-power on the shores of the sounds in the extreme south-west. If, as the reader of the paper suggests, this enormous power can be utilized in the manufacture of nitrate—we hope solely for the purpose of preparing

peaceful products—the result should suffice not only for New Zealand but for Australia also. That continent should provide a large market for fertilizers, for it contains nothing like the water-power resources of New Zealand. We must be careful not to take too parochial, or even too dominional, a view of the resources of a country. It is not New Zealand alone but the Empire, and not the Empire alone but the whole world, which must adjust itself to the utilization of these natural powers. If this paper directs our thoughts to those larger problems it will aid our conception of the future power of geography as a science increased in breadth and dignity, and full of the promise of future development.

Professor C. B. FAWCETT: I have listened to the paper with very great interest as a striking and, I think on the whole, successful attempt to give a general view of the conditions of development in a country which has particularly favourable conditions for, shall I say, experimenting in many kinds of social and national development. The external conditions of New Zealand are such as to allow the Government to direct almost all its attention to the development of its own country. It is very isolated, perhaps in some respects the most isolated country on the Earth. Here I find myself in sympathy with one suggestion made by Dr. Mill, that the paper necessarily dealt with the development of hydro-electric power and its applications wholly inside New Zealand, although indirectly the reference to possible industrial development certainly implies the recognition of the isolation of the country. New Zealand is, I think, about 1200 miles from the populous south-east of Australia and a very much greater distance from any other important area where it could market its products if it had in it the other local conditions for large-scale industry. Directing attention to that sort of consideration is, undoubtedly, very useful for those who are concerned with the study of geography.

There is one other very interesting aspect arising out of this paper: the proportions between urban and rural populations. Taking only the larger towns, which are those that really matter, New Zealand has, as Mr. Buchanan said, 37 per cent of its population in considerable towns. This country has more than twice that proportion, certainly over 75 per cent. That is a proportion on which there is a great deal of somewhat thoughtless criticism by many publicists; most newspapers in reference to it make hasty general assumptions, and I am very glad to see one particular and carefully worked out study where it is indicated that the increase of the proportion of population in towns is not necessarily an evil thing. The actual and ideal proportions vary from country to country. This application of hydro-electric power is one of the factors which may considerably modify the possible distribution of population as between urban concentration and widespread rural settlement, and from that point of view the development of New Zealand is likely to form in the next generation one of the most interesting experiments that we are likely to see in the geographical distribution of population.

Professor UNSTEAD: I am very glad to add my appreciation of Mr. Buchanan's paper to those which have already been expressed. It is a careful and thorough study of an important and interesting problem, and I think the fact that it looks at all aspects of the question renders it really geographical. The correlation between the physical conditions of the industry and its economic and even social applications gives us an illustration of the essential character of geography and its justification.

I was interested in noting that the development of the Power Board in Zealand seems to have been very closely akin to that of the Electricity Commissioners in England, the findings of which have been published and are being worked out.

I would like to suggest that we might be given a little further information with regard to the statistics. There was no reference to the estimates of potential horse-

power from the point of view of whether the statistics are based upon minimum flow of rivers for some period, as in Canada, in regard to which we are given minimum flow as the basis for one figure, and six months flow as the basis for another. In making international comparisons of water-power a statement as to the flow on which the figures are based is, I think, very important.

I was interested, too, in the conclusions of the lecturer as to the possibilities of manufacturing development utilizing the hydro-electric power. A number of useful considerations were brought before us, but I do not feel quite convinced that there will not be a future for industry related to the growth of population which I think one can regard as inevitable. At present there is a very small population of about 1½ million, but as that grows the local demand will grow, and in some directions, possibly first in the woollen industry, an industry might grow up. That again would be the basis of further development of population and consequent demand. When considering such gradual advances, I think the possibilities for the future of manufacturing based upon this water-power were perhaps underestimated, and I feel reluctant to put limits to development in this way. However this may be, I regard the paper as very useful, and am glad to have had the opportunity of listening to it.

Dr. STAMP: I should like, if I may, to express, on behalf of Professor Rodwell Jones, his regret that he has been unable to be present this afternoon. This is a subject in which he is particularly interested, and he is sorry not to be here. I agree heartily with my colleague, Professor Fawcett, in saying how useful such a summary of present hydro-electric development in New Zealand is to us generally.

I have been particularly struck with one aspect of the paper: that we have heard the viewpoint of a New Zealander on his own country, and in the remarks which Dr. Mill made it seems that there is a different standpoint from that from which we in England regard the problem. Several of the points he raised seemed, to my mind, to come from that difference. We as geographers are sometimes rather apt to stress the isolation of New Zealand and its actual world position, and it will be seen that that isolation of position has been reflected in the point of view which Mr. Buchanan has taken.

I was particularly impressed, too, by what I believe to be the almost unique case in New Zealand, the utilization of the power mainly for domestic purposes. We always associate hydro-electric power development primarily with large manufacturing organizations, and it struck me that this was different from what we were used to.

In expressing my appreciation of the paper and its value, might I say that there is one direction in which I personally should have liked to have had further details, and that is the precise position of the potential resources which are not yet developed. It is very striking indeed that the areas which have been developed are not those which are potentially the greatest or most important but have been developed mainly because of their position in relation to the existing population. I think, too, that it is desirable to have in a paper of this sort a certain number of specimen river régimes. While the lecturer drew attention to the regularity of the rainfall throughout the area, this is not necessarily followed in all cases by an equivalent regularity in the flow of the rivers.

Mr. HINKS: I should like to ask the lecturer whether there is any necessary disconnection between the North and South Islands. They were treated separately in his paper. I may confess I am not very clear what is the minimum distance apart from one island to the other. The reason I ask the question is because I was recently at the great Swedish power station at Trollhältan, and when I inquired what they did with the surplus power I was told they exported a large part to Denmark. As I listened to Mr. Buchanan's paper I wondered whether

the North Island could not, if it wanted more power, easily import it from the South Island.

I should like to express, being fond of the country, my horror at the idea of people being driven into the towns while the power stations call the cattle home!

Mr. R. O. BUCHANAN: The main questions that have been put seem to me to be three in number, and I take first Professor Unstead's question about the nature of the statistics of river régimes. I am not sure on what system the statistics of potential power are based. So far as I have been able to discover there has been no publication of bare water-power statistics, and the statistics as published have here and there the words, "seasonal storage assumed"; in other words, the bare results on which Public Works' engineers base their regional calculations are not in my possession. What I have are, apparently, for some rivers average flow, for other rivers average regularized flow. When the flow is regularized there is always mention of the fact, but the total computed includes those two elements, and for purposes of comparison with Canadian records the figures are almost useless. Incidentally, that is merely one instance of a considerable gap in the publication of information that does, in fact, exist. I did mention, I think, the question of lake-levels and of variations in river flow, and measurements have, in fact, been made of certain of the rivers and lakes, but I have only been able to find one example, Lake Coleridge. There are some figures published for variations in Lake Coleridge levels for several post-war years; otherwise, no specific statistics of variations of rivers or of lakes seem to have been published.

Dr. Stamp inquired about the resources not yet developed, and that rather runs along the lines of a question that Dr. Mill suggested, though he did not put it: the future of the large powers that have not so far been developed. Some of those powers are very large. Lake Te Anau is estimated to be able to produce over 1½ million horse-power; Lake Manapouri, close beside it, between 800,000 and 900,000 horse-power. Those sites are relatively inaccessible to present population, but they are relatively close to the deep-water fiords which Dr. Mill mentioned, and in that connection it is interesting to note that just within the last two or three months a concession has been granted by the New Zealand Government to an American company for the development on the sea-coast of 250,000 horse-power from Lake Te Anau power-station for electro-chemical industry. The company are at present testing it; whether the option will be taken up remains to be seen. In that connection, when I gave it as my opinion that New Zealand would not become a great manufacturing country I did not mean to imply that a considerable amount of manufacturing for the home market will not exist. A certain amount exists now. I was thinking, when I used the expression "industrial country," of industry in terms of comparison with countries we now regard as the industrial countries—Great Britain, Germany, and so on. I feel that Professor Unstead is perfectly correct in suggesting that considerable developments may take place, but I think, on the whole, it is unlikely that New Zealand will take its place in the world by virtue of its industry rather than by virtue of its primary production. It is quite possible that it may become a very large world producer and supplier in the electro-chemical industry, but the amount of population necessary to carry on that type of industry is so small relative to the importance of the industry that the country in general would still barely be industrial.

With reference to Mr. Hinks' question with regard to the possible exporting of power from the South to the North Island there are two points: the first is that both islands have more power than they at present know what to do with, so that the necessity for exporting from either island to the other does not yet exist. The second point is that, assuming the North Island did run short, the resources

available at the northern end of the South Island are limited. There are at present three small plants in operation, and apparently the possibilities there, at any rate as suggested by the potential horse-power listed by Mr. Evan Parry, are relatively small. The distance is probably not insuperable; from the beach at Wellington it is possible to see the hills of the other island on a clear day; the distance is actually about 13 miles. Nevertheless, the likelihood of export from one island to the other is not great.

I was very much interested in Dr. Mill's taking the matter one step farther back than I had ventured to do in my paper with reference to the meteorological conditions of the Southern Ocean, in which New Zealand is situated. It was not an oversight that I did not treat of that, but I felt that in the limited space available I should have to consider the distribution as it was rather than go to the meteorological reasons for it. I agree, however, that meteorological conditions are the basis, and that they are in themselves extraordinarily fascinating. I have to thank all the speakers for their very favourable comments.

The PRESIDENT: Mr. Buchanan has given us a very valuable paper on an important subject. The question of the hydro-electric development of New Zealand is one in which we are all, naturally, interested; we feel that New Zealand is very well placed; it is, indeed, in the happy position of having, as the lecturer said, more power than it knows what to do with, which is far from being the case in most other countries in the world. I understand we may class it with Switzerland, North Italy, Norway and Sweden—amongst those countries which really are peculiarly endowed by Nature with this provision.

I was as interested in the question of distribution of population which was mentioned by Professor Fawcett as in any other part of the lecturer's remarks. One cannot help feeling that this system of electric network all over the country will ultimately alter the distribution of population, but it is rather a puzzle to us, whether, as Mr. Hinks remarked, the cows will be called home electrically or whether the net result will be that the population will stay in the country and thus perhaps there will be a larger rural population. We hope that it will be the latter. We always have a sort of feeling that people ought to live in the country, and that they only live in towns because they have to. The difficulties which they have in New Zealand are not the same as we have here. There has been much correspondence in *The Times* and other papers recently as to the beauty or the reverse of pylons which are being carried over our downs. I take it that is not a burning question in New Zealand, but here it is; in fact, so much so that some people say they would rather have no electrical distribution than see those pylons wandering about the downs. That is, of course, by the way.

We have listened to an admirable lecture, a good example of the sort of paper we want on the human geography side. In your name and in the name of the Society I thank Mr. Buchanan very heartily.

AN INTRODUCTION TO GEOTECTONICS

DER BAU DER ERDE: eine Einführung in die Geotektonik. By L. KOBER. 2nd Edit. *Berlin: Gebr. Borntraeger* 1928. 10 × 7 *inches; 500 pages; illustrations and maps. M.27.60*

THE second edition of Prof. Kober's valuable textbook has been greatly enlarged and improved. It has brought up to date his sketch of the sections of geology and geodesy, including gravity measurements and the speed of earthquake waves, which bear on the present distribution of land and water on the surface of the Earth. He represents that distribution as dependent on two elements: the Kratogens, the stable rigid massive blocks, and the Orogens, the flexible zones and fold-mountain belts. Each type has its own distinctive constituents. The rocks of the Kratogens consist of the continental and epicontinental shallow-water formations, the igneous rocks of the Atlantic type, and the "areal" or plateau eruptions, and include no crystalline schists. The Orogenic rocks are the true marine sedimentary series of the geo-synclinals, the igneous rocks of the Pacific type, and crystalline schists. Prof. Kober does not however accept the Atlantic and Pacific rocks as coinciding with different geographical divisions. He declares, in a statement that is noteworthy in reference to some current uses of "sial" and "sima," "there is no Atlantic, no Pacific, no Mediterranean magma. There is neither sal nor sima. There are no deep magma provinces. There are only rocks and series of rocks, which are characteristic for certain zones of the Earth, for certain times and geological events."

In addition to their difference in composition, the two types are defined as having special structures. The Kratogens are affected by three kinds of movement: vertical rise and fall, fracture into horsts and rift valleys (graben), and gentle folding as in the Jura Mountains. The Orogens are affected by the various kinds of complex overfolding and overthrusting developed in Switzerland, and the formation of "klippen."

The main part of the volume is occupied by a description of the continents and oceans in accordance with the author's classification of the morphological units. The continents he represents as based on ten primeval masses, the "Ur-kontinente" or "Archaids." Each is or was surrounded by an Orogenic zone. These elements he regards as permanent throughout geological time; but the continental blocks (his Epirogens) and the Oceanic basins (his Ozeanogens) are unstable and variable, and those of the present time are young. He points out that the Ozeanogens cut across the Alpine mountain lines and are therefore younger, and says that they are among the younger features in the face of the Earth.

The kernels of the continents may therefore be permanent, but their arrangement is not. The lands are dominated by north and south trending dislocations traversed by west to east trending lines of folding. The Atlantic he describes as an Orogen which has sunk between the kratogenic masses and the axis of the Orogen is the Atlantic Ridge. The Indian Ocean he represents as consisting of an orogenic belt that runs north and south to the west of India, and of the Maldives, Laccadives and Chagos; it bifurcates to the south. Hence the Indian Ocean Orogen, according to Dr. Kober, is shaped like an inverted Y separating the three Kratogens, Africa, Australia and Antarctica.

He interprets the Pacific, though his maps show that his views on this ocean are tentative, as composed of two sunken continental masses separated by a mid-Pacific geosynclinal, which traverses Polynesia and crosses the Central Pacific to Central America. The Hawaian Islands are part of his North Pacific Kratogen, and he interprets it as a horst, with a continental foundation and volcanic peaks,

and appearing as Sicily would if it were submerged with only Etna left above sea-level.

Prof. Kober's view is in the main a development of Haug's theory of geosynclinals, which the author criticizes; he recognizes its weak points, such as the failure to explain the vast excess of land in the Mesozoic and the reduction of the sea to narrow canals. But Prof. Kober considers that Haug's work was the first step in the right direction. Like Haug's system, that of Prof. Kober may be too simple and complete. Both have however a firm basis of fact. Prof. Kober's Kratogens are essentially what the present writer called the Earth's coigns, using the crystallographic term for solid angles (*G.J.*, March 1899, p. 245). The relations of the Kratogens and Orogens are not so simple or uniform as is represented. No doubt corresponding geographical units have many important features in common. Thus the Southern Atlantic and the Indian Ocean were both formed by the foundering of parts of the ancient continent of Gondwanaland along north–south dislocations, and various stages of the movements were doubtless contemporary. Despite however the important coincidences, there are striking differences, and there is no adequate evidence for the view that the African mass was surrounded by a fold-mountain zone or orogen which is represented by the Atlantic Ridge, and by a belt composed of the Oman and Sulaiman Mountains and continued across the Arabian Sea to the Seychelles–Reunion–Mauritius group. Similarly, Prof. Kober's view that the Pacific is surrounded by a frame of Alpine chains (as he states on p. 352) appears to the writer inconsistent with the facts as remarked in 'The Structure of Asia' (pp. 23–29). The evidence does not agree, for example, with Prof. Kober's representation of the structure lines in Japan in his figure on p. 292. Nevertheless, despite inevitable differences in the interpretation of some areas, Prof. Kober's correlations seem well established for many of the best-known regions.

Many of the chapters contain an admirable summary of the latest evidence. The account of the Alps is especially valuable as a statement of the views of the East Alpine school, which are less well known than those of the West Alpine geologists. The volume contains many excellent paleogeographic maps.

The two main defects are the absence of an index and the inadequate reference to authorities. There is a list, 17 pages long, of authorities at the end; but many of those to whom reference would be most useful are not included. Thus on p. 93 seven of the authors mentioned are not in the list, and the references to some of those included are to their general well-known books, and not to their less accessible papers. Some of the abbreviations are doubtful, such as N.Z.F.M. (p. 478) which is probably *Neues Jahrbuch für Mineralogie*. J. W. G.

REVIEWS

DAYS IN LAKELAND. By E. M. WARD. *London: Methuen & Co.* 1929. *8 × 5 inches; x + 218 pages; illustrations. 7s 6d*

From the title on the cover it might have been supposed that this book described certain days spent on the fells and in the dales—days such as stand out in the memories of so many who turn to that delectable land for recreation of mind and body. But the words "Past and Present" added on the title-page prepare us for the discovery that here is yet another collection of essays dealing with various aspects of the Lake District at various times. The ground has been well covered by the writings of Mr. W. T. Palmer and Canon Rawnsley (who indeed gave a somewhat similar title to one of his books); the author admits special indebtedness to Mr. W. G. Collingwood, the historian of the Lakes, for facts connected with the past. The present has been brought up to date in respect of such vexed questions as new building, road widening, and afforestation. The remarks on trees past and present have a special value in view of the latest activities of the Forestry Commissioners which fill with apprehension all those who desire to keep the district unspoilt, as far as possible, by alien intrusions. To many of us a coniferous forest in Ennerdale appears almost as out of place as a ribbon of red-roofed bungalows along the shores of Windermere. If we are to have national parks, the English Lake District's claim cries out for first consideration. This book helps to press that claim. J. H. R.

DERBYSHIRE. By THOMAS L. TUDOR. ('The Little Guides.') *London: Methuen & Co.* 1929. (New edition.) *6 × 4 inches; xii + 226 pages; illustrations and maps. 6s*

In securing the services of Mr. T. L. Tudor as editor of this the latest and best volume of their useful series of 'Little Guides,' the publishers have been exceedingly fortunate, and all who read it will consider themselves equally so. Some four years ago Mr. Tudor published his fascinating book on 'The High Peak to Sherwood,' later reviewed in this *Journal* (vol. 69, 1927, p. 458), in which he showed himself possessed of a unique and intimate knowledge of the geography and archaeology of his native county and singularly alive to the varied charms of its scenery. The former edition of the volume before us was compiled in 1903 by the well-known ecclesiastical archaeologist the late Rev. Charles Cox, but the new edition has been in many respects re-written and brought up to date.

The Introduction is of special value and interest, particularly the sections dealing with the general physical features, history, and antiquities of the county. The author reminds us, with a wisdom born of long personal experience, that the only way satisfactorily to see Derbyshire is on foot, through byways and hill tracks where motor-cars cannot pass.

In addition to the numerous pen-and-ink drawings in the text there are several photographic illustrations of great charm which remind us of the delightful pictures among the collection shown in Westminster Hall by the Council for the Preservation of Rural England. To these an article in *The Times* justly drew special attention as "a beautiful series of views of old Derbyshire halls, from which can be learned the dignity of quiet colouring and simplicity of style."

Mr. Tudor deserves the greatest credit for a very valuable and excellent piece of work. W. W.

MEDIEVAL CHESHIRE: an Economic and Social History of Cheshire in the Reigns of the Three Edwards. By H. J. HEWITT. (Publ. Univ. Manchester No. LXCV. Econ. Hist. Series No. VI.) *Manchester: University Press* 1929. xxiv+212 *pages; illustrations and sketch-map.* 21*s*

This is a useful contribution to the series of historical studies which have been produced in recent years. It is a carefully prepared work based on research among original records and documents in many places connected with the county, and it forms a valuable aid for further local studies of Cheshire or the neighbouring areas. C. B. F.

TURKEY AND SYRIA REBORN: a Record of Two Years of Travel. By HAROLD ARMSTRONG. *London: John Lane*, 1930. 9×6 *inches;* xiv+270 *pages; illustrations and sketch-maps.* 15*s*

As may be supposed from the title, this book claims to deal with present-day conditions in Turkey and Syria. Up to a point this is a legitimate claim, but the volume is a dramatic narrative of two years of travel rather than a carefully considered and serious account of developments in areas where things have completely changed as a result of the war.

Captain Armstrong spent some years in Turkey soon after the Armistice; he knows a good deal about that country, and he is an experienced traveller and writer. His present book is the result of a journey, begun in 1927, and made as a delegate of the Commission of Assessment of War Damage. Starting from Beirut, he toured the country now under French control, travelling subsequently into little-visited parts of Anatolia before going to Angora and Constantinople.

No attempt is made to influence the opinions of the reader, who is usually provided with the facts and left to form his own impressions. There are a limited number of references to things which would have been considered modern a few years ago, and the author does not appear to have liked many of the people he met and things he saw during his travels. He provides his readers however with many a vivid story, and carries them right into the lives of the people with whom he has mingled.

He found that the Druses had been beaten into submission but not cowed, and he points out repeatedly that the relations between the French and the people of Syria are not good. Here he may be correct, but in the opinion of the present writer there is no justification for his attack upon the American College at Beirut and upon American work in the Near East. That work may have its shortcomings, but it has been and is undoubtedly the biggest single educational influence between the Adriatic and the Tigris.

In Turkey the peasant is the same as he has always been: the Christians have been practically expelled and the Kurds still seem unsubdued. Angora is different from what it was when the author arrived there in 1916, the lesser Turkish officials are no more efficient than under the Sultans, and as yet nobody can prophesy into what sort of man the new Turkish child will grow. The people have gladly shed their religion; Constantinople, the same outwardly, has gone through an inward change, and, from the practical standpoint, nothing has been done to rebuild Smyrna, destroyed by the fire of 1922. H. C. W.

ALAI! ALAI! Arbeiten und Erlebnisse der Deutsch-Russischen Alai–Pamir-Expedition. By W. RICKMER RICKMERS. *Leipzig: F. A. Brockhaus* 1930. 9×6 *inches;* 300 *pages; illustrations and map.* *M.*15 (*unbound M.*13)

The work of the Alai–Pamir Expedition will already be familiar to readers of this *Journal* through the general account of the work which was given by the leader, Dr. W. Rickmer Rickmers, at a recent meeting of the Society in the spring of

1929 (*G.J.*, 74, 1929, pp. 209–231), and also through the review of the preliminary report of the work which was published in the *Journal*, 74, 1929, p. 598.

The first 188 pages of the present book are the author's diary for the journey, extending from May 9 to November 28. Then follows a section comprising extracts from the letters or diaries of other members of the Expedition. The third section deals with the plan of the Expedition, and the fourth is a special description of the Turanian Doab. The narrative is full of interest, and there can be nothing but praise for the beautiful series of illustrations. Those printed from copperplate are particularly striking and attractive. A few have already been published in the *Journal*. A curious misprint on p. 11 may lead the reader to think that the whole expedition took place in 1929 instead of in 1928. L. D. S.

CHINA: eine Landes- und Volkskunde. By GEORG WEGENER. *Leipzig & Berlin: B. G. Teubner* 1930. 9×6 *inches; 234 pages; illustrations and maps. M.12 (unbound M.11)*

Dr. Georg Wegener is the author of a book which was noted in the *Journal* for August 1927, p. 177, entitled 'Im innersten China,' and which is a record of journeys which he carried out some years ago in the heart of Southern China. He has now written a small general book on China, which he divides into four parts: the Land, the People, the History of China from the beginning of the nineteenth century up to the revolution, and Modern China. Written by one who speaks with authority because of personal knowledge of not only the outskirts but also the interior of China, and who was for many years the teacher of geography in the Technical High School of Berlin, it is a book which may be regarded as a model of its kind. It combines both geography and history, and is therefore a handbook of very general interest at the present time when China is attracting so much attention. The illustrations deserve nothing but praise; the photographs have been carefully selected and illustrate most phases of life in China. It is rarely that one gets in the same volume such excellent pictures of typical Chinese people and cultivation, together with those of great figures in modern Chinese history, such as Sun Yat Sen and the young general, Chang Kai Shek. This is a book which deserves to be widely known and used. L. D. S.

DER HWANG-HO: Eine Physiogeographie. Von Dr. Gunter Kohler. *Gotha: Justus Perthes (Petermanns Mitteilungen*, Ergänzungsheft n. 203) 1929: *104 pages; illustrations and map. M.18*

This well-arranged and well-documented monograph is divided into three parts: the first dealing with the basin of the river, the second with the river itself, and the third with its morphological history. Not the least remarkable feature of the Hwang Ho is the diverse character of the regions comprised within its basin. No less than seven regions are distinguished: the middle Kunlun, the Chinese Kunlun, the northern mountain rim of China, the Kansu–Shensi mountainous country, the Ordos tableland, the grid mountains of Chihli and Shansi, and the North Chinese lowlands. There is an essential contrast between the upper course on the Tibetan plateau, the middle course with its deep gorge through the Ordos plateau, and the lower sluggish course on the North China plain.

Perhaps the most interesting part of the monograph is the last. According to the author's interpretation the Hwang Ho is essentially a young river. He believes that the upper course at one time flowed into the Yangtze Kiang, and that at a later time the main valley was that now occupied by the Wei Ho. It was during the Pliocene that this part of the valley and several others became filled up with large quantities of alluvium, with the result that the upper course probably entered a large freshwater lake. This eventually spilled over and so gave rise to

the post-Pliocene and present course of the river around the Ordos plateau, the outlet towards the Yangtze having already been blocked by large masses of glacial gravel from the glaciers of the eastern Kunlun. Doubtless the water derived from the Tibetan plateau assisted the Hwang Ho in cutting its enormous north-south canyon from Hokow to Puchow. Although in the north-western part of the Ordos plateau the river has changed its course within historic time, leaving an abandoned channel which can still be clearly followed, it is in the lower course of the river that changes have been so frequent. The Hwang Ho passes through the plateau region in a canyon which controls its course for many hundreds of miles, and emerges quite suddenly on the plains as a river perhaps more fully charged with mud than any other river on earth. But here on the plain it still has a course of several hundred miles before the sea is reached. In the last four or five thousand years the river has changed its bed in this part at least seven, and possibly ten, times. Several factors have contributed to these changes: the huge deposit of mud, which tends to silt up the bed of the river; the type of irrigation practised by the Chinese, namely the dyke and levee construction, so that at the present time the river runs above the level of the plain; the load of material brought down by rivers flowing from the north, which tends gradually to push the Hwang Ho itself farther south; the agricultural utilization of this flat land; and the floods, caused in this river by the monsoonal rhythm of the rainfall over practically the whole basin.

Dr. Kohler's monograph is one which should not be neglected by any serious student of river action, and at the same time it is an important contribution to the study of the tectonic development of Eastern Asia, in that it shows the effect and traces the history of the tectonic movements as shown by one of the greatest rivers. Probably also the clue to the climatic changes in the basin will be given by such a detailed study of the river itself. L. D. S.

A HISTORY OF THE FAR EAST IN MODERN TIMES. By HAROLD M. VINACKE. (The Borzoi History Series.) *New York: Alfred A. Knopf* 1928. 10×6 *inches;* xx+480 *pages; and maps.* $4.00

"Modern," writes the author in his preface, " is defined in terms of the Far East rather than of Europe"; so after a first chapter descriptive of China under the Manchus, he starts his story with the opening of China to European trade in the nineteenth century, and devotes it almost entirely to the events of the last sixty years in the Far East. It is thus the story of the impact of the West on China and Japan and their reaction to it. As to the plan of the book, he writes: "The streams of Japanese and Chinese history ran in separate channels until the struggle over Corea caused them to converge. After 1895 they continued to diverge somewhat, but never as widely as in previous years. The attempt has been made to follow these natural lines of development. Sometimes the two streams are brought together, and at other times they are allowed to separate; but most of the time the two main channels are fed by waters from Europe and America, from Corea, Indo-China, and Siberia." Following this plan the author gives a full account of the immense changes which have come over the Far Eastern countries in recent years—the transition in Japan, her struggle with China and Russia, the pressure of the Western Powers on China, her revolution and the subsequent struggles and rise of the military power in the country. He takes account in separate chapters of intellectual and cultural progress in China and Japan, and surveys the results of the war and the present situation in the Far East and the relations there of East and West. His account is full, straightforward, and interesting, and the subject with which he deals one whose significance in the general history of the world it would be hard to exaggerate. E. A. B.

FOREIGN COLONIAL ADMINISTRATION IN THE FAR EAST. By Sir HESKETH BELL, G.C.M.G. *London: Edward Arnold & Co.* 1928. 9×6 *inches;* xii+302 *pages; and map.* 16*s*

Sir Hesketh Bell's book is based on his observations during a visit to Java and Indo-China in 1926. He sketches the main lines on which the Dutch and French govern their large and important colonial possessions in the Far East. His object has been not only to interest the ordinary reader, but to provide for British administrators of tropical territories material for a comparison between the system of native administration existing in some of our protectorates and those which the French and Dutch have organized in theirs. As he writes in his concluding pages, "The three great colonizing nations of the world—the British, the French, and the Dutch—now control the destinies of one-third of the inhabitants of the earth." The happiness of all these millions depends to a great extent on the wisdom of their rulers' policy, and what that policy should be has to be learned by experience. "It is therefore essential that every effort should be made to avoid the purchase, several times over, of the same experience." "Lessons learned . . . should be pooled for the mutual benefit of all the civilizing powers." There can be no doubt of the immense value of such comparative studies in administration as that which these pages represent. Different as the various European nations are in their genius and in their traditions of colonization, they have much to learn from each other for the saving of their own labour and expense, and for the advantage of the races under their power. In their turn and in different ways all are facing the same problems, political and economic. Conspicuous now is the problem of associating the people with the Government, and the author's account of the working of "indirect rule" and of the introduction of representative and consultative assemblies in Java and Indo-China will be read with great interest.

E. A. B.

JU-JU AND JUSTICE IN NIGERIA. By FRANK HIVES and GASCOIGNE LUMLEY. *London: John Lane* 1930. 9×6 *inches;* xii+254 *pages; illustrations and sketch-map.* 12*s* 6*d*

This book provides a striking picture of life among the cannibal Aros of the Cross River region of Nigeria. Seldom have we read a better description of the paralysing terror which the Ju-Ju inspires, pervading every aspect of tribal life with an atmosphere of lurking doom. Early in the present century Mr. Hives was sent as District Commissioner into the Aro country to take over a district which was only nominally under administrative control. Hidden away in the forest the natives still maintained powerful ju-jus which constantly demanded human sacrifice. The first part of the book is largely an account of these ju-jus, and of how Mr. Hives succeeded in discovering their hiding-places and breaking them up, work in which he was constantly beset by every sort of peril.

Probably his most successful *coup* was the destruction of the Kamalu Ju-Ju, which was run on the same lines as the more famous Aro-Chuku Ju-Ju. Its secret was well kept, but a chance remark between two natives at last gave the necessary clue. The story of its discovery amid scenes of revolting barbarity and of the capture of its chief priest makes thrilling reading. Scarcely less enthralling are the two chapters which describe an unsuccessful attempt at peaceful penetration among some wild Munshi tribesmen. It ended in precipitate flight, after a hair's breadth escape from being eaten by the natives into whose hands Mr. Hives and his followers had fallen.

The book is frankly a tale of wild adventure amid scenes of profound horror which often cause the reader to marvel at the depths of depravity to which the human race can descend. It is one of the best books of its kind we have read. It

owes much of its effectiveness to the admirable restraint with which it is written, and for this great credit is due to its unobtrusive editor, Mr. G. Lumley.

E. W. B.

KENYA MOUNTAIN. By E. A. T. DUTTON. With an Introduction by HILAIRE BELLOC. *London: Jonathan Cape*, 1929. 11×7 *inches;* xvi+218 *pages; illustrations and maps.* 21*s*

KENYA: from Chartered Company to Crown Colony. Thirty Years of Exploration and Administration in British East Africa. By CHARLES W. HOBLEY, C.M.G., C.M.Z.S., F.G.S. (With a Foreword by the Rt. Hon. W. G. A. ORMSBY GORE.) *London: H. F. & G. Witherby*, 1929. 9×6 *inches;* 256 *pages; and illustrations.* 16*s*

Mount Kenya, with its superb rock scenery, its nine or more glaciers, its twenty tarns and lakes, and its remarkable Alpine flora, is one of the chief geographical assets of Kenya Colony. It should made a delightful holiday resort and mountaineering centre. A worthy monograph on the mountain has now been issued in a handsome volume by Mr. E. A. T. Dutton and illustrated by fifty-six beautiful photographs by Mr. J. D. Melhuish. They are well reproduced and graphically show the extent of the glaciers and the difficulty of the rock climbing, and are an important contribution to the geography of the mountain. The summit was reached after an arduous climb by Sir Halford Mackinder and two Courmayeur guides in 1899. Mr. Dutton visited the mountain to attempt the ascent in 1926, in company with Mr. Melhuish and a large party of natives. They approached the peak from the eastern side, crossed the Lewis Glacier and, provided with a ladder for help over the low rock faces, essayed the climb along nearly the same route as Mackinder's. The chapter on the final attempt indicates that the author was hopeless when it began; the start was late; the natives careless and incredulous as to the possibility of success; and under the conditions described it is not surprising that the effort was abandoned at about 16,500 feet, despite the author's careful and elaborate preparations.

The book includes a series of appendices on the mountain, including a useful index to the place-names, a chapter on the flora by Lady Jex-Blake, on the forests by Mr. S. H. Wimbush, on the Mwimbi, a local tribe, by Mr. H. G. L. Gurney, and on the geology by the reviewer.

The author later visited and described a previously unnamed lake low on the eastern slopes.

The volume is illustrated by three sketch-maps and a copy of the Geographical Section of the General Staff Map of Kenya on the scale of 3 inches to the mile, on which the author's routes are marked.

Mr. Hobley's book is on different lines, as it records the personal experiences and observations, and states the considered judgments of a man who has enjoyed unique opportunities owing to thirty years' varied service in Kenya Colony. He was trained at Birmingham as an engineer and was given a bent to geology by the teaching of Lapworth. He was sent to the country in 1890 on the staff of the British East Africa Company to investigate its mineral resources; but as that mission was premature he was employed as surveyor in the coastal districts and on various branches of the general administration. After the failure of the company he was transferred to the Government service and became Senior Provincial Commissioner and at times Acting Governor. He held appointments in many parts of the Colony and played an important part in the pacification and settlement of the Kavirondo country. He was one of the pioneers in the exploration of the Tana and Mount Kenya, where the name of the Hobley Valley recalls his journey to it in 1891.

Amongst other useful contributions, in conjunction with Sir Frederick Jackson he founded the Uganda and East African Natural History Society in 1910.

His book will be an indispensable guide to the historians of Kenya Colony and is full of interesting experiences and adventures. The author's keenness as a naturalist is shown by his accounts of the migration of the elephants, observation on crocodiles, large game, birds, and insects. His own most important studies were in ethnology. His opportunities in that department were exceptional, as he gained the confidence of the natives when they were first in contact with Europeans and before they were materially influenced by foreign ideas and ways.

Mr. Hobley's book on 'Bantu Beliefs and Magic,' and his numerous contributions to the technical journals are among the primary documents on the anthropology of East Africa. His new book throws much light on the recent history of Kenya Colony; he was associated with all its governors and chief officials, and his comments are illuminating and astute. He always saw the best side of his colleagues and his personal sketches are always friendly. He interests his readers in the country owing to his affection for it, and does his best to inspire confidence in it and its future. Nevertheless his judgments recognize the essential conditions. He discusses the question of European acclimatization in the colony, and is obviously doubtful as to its ultimate success. He quotes the opinion of a leading medical practitioner there as to the ill effects, especially on the nervous system of Europeans, of long residence at over 5000 feet above sea-level. This medical authority considers that the European settlers must make regular and long visits to Europe. If so European colonization is impracticable, and the country must be developed by planters employing native labour. Mr. Hobley considers the question not yet settled, and would like to see a complete European colony established at the height of over 6000 feet in order to solve the problem by an adequate experiment. He approves of the system of government advocated in Lord Lugard's 'Dual Mandate.' He describes the present representation of native interests on the Legislative Council as "lamentably weak," and holds that as the natives pay half the annual revenue of the country their representation should amount to half the Council

He recognizes as one of the fundamental difficulties of the present situation the fact that only a small proportion of the European settlers are "real colonists," and that at least 75 per cent. of them "always have their eyes on the homeland, and mean eventually to return there." He is also impressed by the dangers of miscegenation and the development of a race of "poor whites," and does not see how under the present conditions these evils are to be avoided. J. W. G.

OUT OF THE CRUCIBLE: being the Romantic Story of the Witwatersrand Goldfields. By HEDLEY A. CHILVERS. Illustrated by WILLIAM M. TIMLIN. *London: Cassell & Co.* 1929. 9×6 *inches;* xiv+274 *pages; and illustrations.* 7*s* 6*d*

In October next Johannesburg will be forty-four years old. Probably no other town has achieved such fame, or made so much history, in so short a period and it is a good thing, while there are many still alive who can remember when the city was not, that its story should be recorded by a competent authority. That Mr. Chilvers is; he was present at the birth of the city and has followed its fortunes ever since. More, he knows its pre-natal period—the search for and the discovery of gold along the Witwatersrand. The discovery was made by Mr. Fred Struben, who was the first to "prove" the fields and who formed his first syndicate in March 1884, over two years before the goldfields were proclaimed.

From that date right on to last year Mr. Chilvers tells the tale of the "golden

city" from the rush of the magnates to secure claims, the early days, when a goodly proportion of the inhabitants were of dubious character—they included the infamous murderer Deeming; the influx of the uitlanders, the troubles with the Boers, the Reform movement and the Raid, down to post-war development and the Communist revolt. It is all told with great animation, and well-informed readers will find here and there hitherto undisclosed facts which make clearer some doubtful episodes in South African history. Such readers may, however, wonder at the author's economy is describing the Chinese coolies experiment, for it is told as if Milner played no part in it.

Mr. Chilvers has the power of dramatic narrative, which he has many opportunities to employ: his account of the gang whose exploits led to the death of General Delarey may be instanced. Occasionally his zeal seems to betray him into attributing too much importance to the part the Rand has played in world history, and it is surprising to find him speaking of the Prince of Wales (Edward VII) as "Prince Edward." And were Jameson's officers or is the author responsible for misquoting "Fain would I climb"? But the blemishes in the book are few and its merits many. Not the least of those merits are the pen-and-ink drawings by the very able South African artist, Mr. William M. Timlin. F. R. C.

CANADA WEST. By FREDERICK NIVEN. (The Outward Bound Library.) *London and Toronto: J. M. Dent & Sons* 1930. 7×5 *inches;* xi+188 *pages; illustrations by* JOHN INNES, *and map.* 5*s*

This new volume in Messrs. Dent's "Outward Bound Library" will not disappoint expectations. In Mr. Frederick Niven they have a writer who from his long residence and experiences in Western Canada is very capable of saying all that need be said about it in a work of the kind. He touches briefly on its history, and a chapter is devoted to the great question of immigration. He describes the astonishing development of the prairie cities, such as Winnipeg, Edmonton, and Calgary, and gives glimpses of life in the more out-of-the-way parts. The chief activities of the people are dealt with, and there is an interesting chapter on "Hints for the Tenderfoot," which, in view of the efforts that are being made to induce emigrants from Great Britain to settle there, should prove useful. The book concludes with a description of a journey to the Yukon and the goldfields of Klondyke. Any one interested in, or going to, Canada West, cannot do better than consult this small volume. A. W. S.

RECHERCHES SUR LE COMMERCE GÈNOIS DANS LA MER NOIRE AU XIII^{e} SIÈCLE. By G. I. BRATIANU. *Paris: P. Geuthner* 1929. 10×7 *inches;* xii+359 *pages; illustrations and map.* 12*s* 9*d*

The extent to which geographical knowledge in the Middle Ages was indebted to the merchant trader is again emphasized in this valuable and well-documented monograph. Among the Mediterranean peoples the Genoese played the leading part, not only in the west, in the service of Spain and Portugal, and in North Africa, but also in the Levant and the Black Sea. If this present work of M. Bratianu's upon their penetration of the latter area does not entail a complete revision of former opinions, his researches in the Genoese archives, and his knowledge of the more inaccessible results of modern scholarship in Eastern European history, enable him to amplify the narrative and to elucidate points hitherto obscure.

The critical event for Genoese commerce in the East was the conclusion of the Treaty of Nymphae with the Byzantine Empire in 1261, which admitted them to the Black Sea on terms more favourable than those granted to any other nation. Previously, they had competed against the Venetians with varying fortune. M.

Bratianu traces their efforts to open up an overland route alternative to that through the Bosphorus. The first Genoese privilege in Lajazzo dates from the beginning of the thirteenth century: thence, *via* Anabad and the Halys, a route to Savastum (Siwas) was established, which in turn opened the way to the shores of the Black Sea, or to Persia. After 1261, Genoese activities in that region increased rapidly, and, as an anonymous contemporary poet records, "Che unde li van e stan Un atra Zenoa ge fan." The author shows that there was a consul at Caffa at least as early as 1285, and probably from 1266.

Another interesting point upon which he touches is the relation of this expansion to the development of cartography. The earliest portolans, of the end of the thirteenth century, show a fully developed outline and nomenclature for the Black Sea, which scarcely changes in succeeding specimens. This coincidence with the commercial expansion of Genoa strengthens the argument for a Genoese origin of these charts, may explain their sudden appearance in the late thirteenth century, and supports the theory of Byzantine influence in their evolution. M. Bratianu deals with other points, too numerous to be more than noted here: the fortunes of the Venetian-Genoese struggle, the commercial links between the Levant and Western Europe, and, most particularly, the relations between the Genoese and the rulers of Persia and Central Asia. The dominance of the Mongols, as is well known, opened, momentarily, those areas to missionaries and traders, the greatest and most influential of whom was Marco Polo.

It will be realized how wide is the interest of this book. Though by no means easy reading, it is saved from becoming a wilderness of mere facts by the author's sure grasp of the main currents of contemporary progress. G. R. C.

EMIGRATION FROM THE BRITISH ISLES: with special reference to the development of the Overseas Dominions. By W. A. CARROTHERS. *London: P. S. King & Son* 1929. 9×6 *inches;* xii+328 *pages.* 15*s*

This is a valuable book by the Professor of Economics in the University of Saskatchewan, a book which should be in the hands of all who are interested in population problems. It is packed full of information, but is not dull reading. The author sends forth the book "in the hope that it may be of some assistance in removing the idea that the migration problem is simply that of recruiting and transporting migrants, and that it may also help some to appreciate the social, economic, and psychological background of the movement." He begins with accounts of early settlement in Canada and in Australia at the end of the eighteenth and beginning of the nineteenth centuries. And, in this connection, we are given a sketch of the migration of the United Empire Loyalists from the States to the Maritime Provinces of Canada, and we are shown how much Canada owed, even in those early days, to the successive ventures of Highlanders from Scotland. There is a brief history of the early troubled days of Australia, a difficult period which may be said to end with the coming of Governor Macquarie.

Turning to Great Britain and Ireland, the author describes the conditions at home, as affecting emigration, after the close of the Napoleonic wars. He points out the rapid increase in population in the first twenty years of the nineteenth century; the artificial prosperity enjoyed as a result of the wars, with lessons for us in similar conditions; the demoralizing system of poor relief; the conditions in Ireland, working up to the tragedy of the Great Famine. The first President of the Royal Geographical Society, Lord Goderich, afterwards Lord Ripon, was no friend of assisted emigration in the 'thirties. He was an important factor in the case because he was Secretary of State for the Colonies. In 1831 he acted on Wakefield's theory and approved of the sale of land to the colonists in Australia only by auction, at a fixed minimum price. This theory, and the other ideas of

Wakefield, occupy a large space in the book. In the words of the author, "the Wakefield system had caused emigration to appeal to a much better type of citizen during the 'thirties." Briefly, his system consisted of the sale of land, selection and assistance of colonists, and the building up of a scheme of self-government. There is an interesting chapter on Canada and the Durham Report, which, as regards migration, was largely inspired by Wakefield.

One chapter deals with The Lull in Emigration, which is noted as occurring during that very prosperous period 1850 to 1875. Then we find twenty years or so of depression, both industrial and commercial, and the author points out that this depression did not produce its effect on emigration until 1878. There was in fact a lag, as might have been expected. There is the other side of the picture in the effect of depression in the Dominions on the outward flow of migrants from Great Britain.

For us the most important part of the book is the analysis of the Migration Problem To-day. The Imperial Economic Conference of 1923 reported that the "redistribution of the white population of the Empire in the best interests of the whole British Commonwealth, is [a problem] of paramount importance, especially as between Great Britain on the one hand, and Canada, Australia and New Zealand on the other." The opinion of the author is that this policy, as embodied by the Empire Settlement Act, has failed. The Overseas Settlement Committee has, without doubt, done its best, but the results have been disappointing. Some part of the failure is due to the various schemes of social insurance in Great Britain. But now there comes in another factor. Since the book was written the Australian Government has decided, in December 1929, to ask for a suspension of assisted emigration to the Commonwealth. And generally, apart from this, the emigration figures have been rapidly falling. In other times, periods of industrial depression were to a considerable extent relieved by a vigorous emigration. Now, we have depression in industry coinciding with a marked falling off in emigration. But all this occurs at a time when the natural increase in the population of England and Wales is smaller than it has ever been since the commencement of the industrial revolution.

There are no short cuts to the solution of these problems: birth rates, migration rates, standards of living, industrial prosperity, are all interwoven. Government action has not often been effective, and sometimes one is tempted to agree with Gordon when he said, "The Government never made England great." It is by the exercise of the individual common sense of the citizens of the British Commonwealth of Nations that we must chiefly look for a satisfactory way out of our population difficulties. But at home, with a rapidly diminishing birth-rate, and with every probability of a stationary population in the near future, a relatively small amount of emigration would satisfactorily relieve any undue pressure. And the Dominions are fully alive to their own conditions and requirements. All who are interested in these matters, which have such an important bearing on the future of the Empire, will be well advised to read Mr. Carrothers's clearly told story of Emigration from the British Isles. C. F. C.

RÉPERTOIRE DES MÉTAPHORES ET MOTS FRANÇAIS TIRÉS DES NOMS DE VILLES ET DE PAYS ÉTRANGERS. Par FÉLIX BOILLOT. *Paris: Les Presses Universitaires de France. London: Humphrey Milford* 1929. 9×6 *inches;* 124 *pages.* 25 *fr.*

This is a curious compilation. It is an attempt to classify under certain headings and sub-headings all foreign place-names that have passed in some form or other into the ordinary vocabulary of the language, as we use the phrases French leave, Siamese twins, Turkish delight, or the words champagne, charleston, pekingese,

and a hundred others. According to the statistical tables Great Britain comes third after Italy and Greece in providing such words in French. Among these we find entries like "Rugby, sorte de jeu de football," "Limerick, petite poésie de cinq vers, généralement humoristique, souvent grivoise," "Derby, chapeau de feutre dur à petits bords (*billy-cock hat* en anglais)." We have never met at the Smithfield Show the "race bovine anglaise élevée pour la boucherie" called Durham, and should have expected Dundee to appear as a species of cake rather than as a make of "confiture d'oranges." Chester (*sic*) cheese and York ham are our contributions to "alimentation." The word "anglaise" occurs in all kinds of phrases, but probably some of its uses have been discreetly omitted, as in an amusing introduction the author observes that all nations have a tendency to employ such terms in an uncomplimentary sense and deplores this "Xénophobie" or "perversion du patriotisme."

It is difficult to take this work seriously, but we may call attention to wholesale omissions under the head of geology. The word "Oxfordien" is given as "la partie inférieure de la série supra-jurassique," but "jurassique" itself does not appear, nor other leading terms like "cambrien, dévonien, permien" (not to mention many sub-divisions), while the mineralogical section is a mere ghost of what it might have been. J. H. R.

SUPERSTITIONS OF SAILORS. By ANGELO S. RAPPOPORT. *London: Stanley Paul* [1929]. 9×6 *inches;* 288 *pages; and illustrations.* 15*s*

In this book the author introduces the reader to some of the many superstitions of the seafaring community, and describes some of the various beliefs still current with regard to the origin of the sea itself. The range of topics with which he deals is certainly comprehensive, for it also includes "water-sprites, apparitions, mermen and mermaids, dolphins, the barnacle and oysters . . . the belief of seamen in omens for good and evil, and the days and events which have an influence upon their superstitious minds." The author gives examples of folk-tales dealing with the sea. His claim that his book forms a valuable and interesting contribution to the science of Folk-lore is certainly well founded.

The book appears to be a translation from some foreign language, but what that is does not appear. The text itself contains many typographical errors as well as others due to faulty grammar. A number of references to Japanese mythology occur, but many of the proper names quoted are quite unintelligible, and it is difficult to grasp what may be the system of Romanization by which their form is regulated. At the same time, although many instances of maritime superstition familiar to the Far Eastern seas are not mentioned, there is much that will interest the reader in those to which reference is made. W. W.

THE MONTHLY RECORD

MEDALS AND AWARDS, 1930

His Majesty the King has approved the award of the Royal Medals as follows: The *Founder's Medal* to Mr. F. Kingdon Ward for his geographical explorations and work on botanical distribution in South-West China and South-East Tibet; the *Patron's Medal* to Mr. C. E. Borchgrevink for his pioneer Antarctic Expedition of 1898 to 1900, which was the first to winter in the Antarctic, to travel on the Ross Barrier, and to obtain proof of its recession. The Council have awarded the *Victoria Medal* to Monsieur Emmanuel de Margerie for his distinguished contributions to the Science of Land Forms; the *Murchison Grant* to Colonel H. Wood, R.E., for his surveys with the Tibet Mission and the De Filippi Expedition to Central Asia; the *Back Grant* to Mrs. Gordon-Gallien for her expedition to the Kalambo Falls; the *Cuthbert Peek Grant* to Mr. Owen Lattimore for his travels in Mongolia and Chinese Turkistan; the *Gill Memorial* to Lt.-Col. Reginald Schomberg, D.S.O., for his explorations in the Tarim Basin and the Tien Shan.

A BOTANICAL EXPEDITION IN PERSIA

A botanical journey to Persia in connection with the Empire Marketing Board and the Ministry of Agriculture and Fisheries, by Dr. J. M. Cowan of Kew Gardens, and Dr. C. D. Darlington of Merton College, Oxford, is described in the Kew *Bulletin of Miscellaneous Information*, No. 2, 1930. The journey resulted in a valuable collection of living bulbs of tulips and other plants as well as living specimens and seeds of economic interest. At the time of departure from London in February 1929 the whole of Europe was so deeply locked in snow that it was considered expedient to travel to Port Said by sea. The journey across the Sinai Desert and through Palestine was made chiefly by train, and the Syrian Desert was crossed by motor coach. At this time the Desert had had rains and there was a remarkable growth of dwarf vegetation affording sustenance to vast numbers of cattle. Travel in Persia was by motor car, the route being from Khanaqin, on the 'Iraq frontier, south-eastward to Isfahan, then northward through Tehran to Tabriz, and thence to Batum, London being reached again at the end of July.

Vegetation in Persia varies of course with the great differences of altitude met with in that country and with the general increase of rainfall from south to north. At altitudes of even 3000 feet the appearance of rice-fields and buffalo as in India indicated a hot climate, whereas everywhere on the plateaux above 5000 feet there were heavy snow-drifts, even at the end of May, at the highest levels reached. The Persian highlands would appear, from this and other accounts, to share somewhat in the heavy winter snowfall of all the high plateaux of South-Western Asia. The plateau country between the 'Iraq frontier and Hamadan was bleak and arid, but here and there crocuses and irises were found in full bloom following the retreat of the snow at the end of March. Very few trees were observed in the more southern parts of Persia traversed except near the villages, where poplars, willows and various fruit trees were abundant. Northward of Tehran the country became much greener, especially near the streams coming down from the Elburz range. The soil of Persia is, in fact, stated to be exceedingly fertile wherever sufficient water is available. From Tabriz excursions were made to Lake Urmia on the west and to Astara on the shores of the Caspian on the east. Near Lake Urmia the landscape was a blaze of buttercups, recalling the meadows round Oxford in early summer. The lower hills here have a sparser vegetation than the higher, apparently because of diminished

precipitation. Between Tabriz and Astara hawthorns, wild roses, oaks, and elms became frequent as the travellers approached the zone of heavy rainfall up to 70 or 80 inches a year on the Caspian shores. Here there is dense forest of evergreen forms of maple, beech, lime and other species.

The paper affords an interesting glimpse of the Persian countryside and of conditions of travel in that country. The authors express their appreciation of facilities rendered by consuls, missionaries, and others.

REINDEER FOR NORTHERN CANADA

The successful introduction of the domesticated reindeer into Alaska within the past forty years has suggested that a similar experiment might with advantage be carried out in Northern Canada, where changing conditions have of late years prejudicially affected the means of sustenance of the remnant of the original Eskimo population. With the establishment of trading posts along the Arctic coast, to satisfy the increasing demand for the fur of the white fox, the Eskimo has changed from hunter to trapper and largely depends for his necessities on European supplies. The change has been by no means beneficial, and the Canadian Government has felt the importance of broadening the basis of the native's sustenance by building up the numbers of the larger animals of late so seriously reduced. In April 1926 an experienced botanist, Mr. A. E. Porsild, was appointed to conduct an investigation of the grazing possibilities of certain promising areas, and this he successfully carried out with the aid of his brother, Mr. R. T. Porsild. Between May 1926 and November 1928 they traversed a total of 15,000 miles, by dog-team, canoe, motor boat, pack-dogs, and snow-shoes, and brought back probably the largest single botanical collection ever made in Arctic America. Their report was issued in 1929 by the Canadian Department of the Interior, and is of much interest not only in connection with the immediate object of the journeys, but from the geographical details on areas still imperfectly known.

The investigations were inaugurated by a visit to Alaska for a study of the reindeer industry there, on which interesting details are given. Then the brothers got together two dog-teams and traversed the whole Arctic coast of Alaska, experiencing most unpleasant conditions en route. Within Canadian territory the first area to be studied lay in the Mackenzie delta and the country to the east as far as the Anderson. When caribou were plentiful this had been the hunting-ground of the Mackenzie Eskimo, but now it is never visited. After examining Richards island (July 1927) the travellers followed the coast (then clear of ice) to the north-east, returning by the chain of the Eskimo lakes which almost link Liverpool Bay with the Mackenzie and are navigable throughout by boats drawing up to 8 feet. The plain between the lakes and the coast is low and marshy and affords excellent summer pasture for reindeer. In February 1928 they started up the Mackenzie with dog-teams, on their way to the Great Bear Lake (the country north of which was the second area to be studied), deep snow making travel difficult. Geographically the account of the Bear Lake and its surroundings is of special interest. The greatest diameter of the lake was found to be considerably greater than estimated by Sir John Richardson—183 instead of 150 miles—and a number of soundings were taken during traverses of the lake, giving an average depth of 50–60 fathoms and a maximum of 75, showing that the lake bottom is here below sea-level. Observations were also made of a rhythmical oscillation of the water-level, a rise and fall of 6–7 inches being found to occur seven or eight times in twenty-four hours. From a base at the mouth of Dease river the northern plains were examined, while subsequently the very sinuous shore-line of McTavish arm—only vaguely indicated in existing maps—was studied. The report gives details as to the nature and distribution of tree-growth, the climatic

conditions on the lake, the break-up of the ice, and so on. Its latter part sums up the grazing possibilities of the various areas, which seem distinctly promising, some being adapted for use at one season, some at another. There is also a section on transport facilities.

NEW AMERICAN OCEANOGRAPHIC INSTITUTION

We have received from Dr. Bigelow of the Museum of Comparative Zoology, Cambridge, Mass., notice of the establishment of a new Oceanographic Institution at Woods Hole, Massachusetts. This new institution is the outcome of a report on the recent status of oceanography submitted to the National Academy of Sciences at the Princetown Meeting in November 1929, by its Committee on Oceanography, of which Dr. Bigelow is the secretary (see *Science*, vol. 71, pp. 84–89, and pp. 277–278 for a fuller notice of the Woods Hole Oceanographic Institution). Its purpose is stated to be "to carry on and to encourage the study of the sea in the broadest sense." Woods Hole has been chosen as the site for the headquarters of the institution because of its proximity to two famous laboratories of marine biology and because the waters in its neighbourhood offer exceptional opportunities for many kinds of investigations, the transition from inshore to onshore waters here being abrupt, and the Continental slope can be easily reached, while the Gulf of Maine, close at hand, with its deep troughs open to the ocean, enclosed sinks, irregular coast-line, varied depths, and rich fishing banks, offers for solution problems touching many aspects of oceanography. At the same time the waters off Woods Hole show a remarkably wide thermal range, regional, bathymetric, and seasonal, and the local waters generally a great diversity of pelagic flora and fauna. There are also opportunities for the study of Arctic ice in the proximity of the Labrador Current and of mid-ocean conditions in the Atlantic, with the Bermudas as the possible site for a sub-station in the future.

It is indeed one of the main aims of the Woods Hole Oceanographic Institution to own and operate a moderate-sized sea-going vessel, capable of considerable voyages and equipped to carry on all kinds of investigations at various depths. The Institution hopes to give visiting oceanographers, both from America and from abroad, opportunities for taking part in organized investigations and also, so far as may be possible, for collecting independently such data as can be obtained from the pier or from small boats. It hopes, further, to offer to university students instruction in oceanographic methods both on cruises and in its laboratory.

The Institution is fortunate in receiving from the Rockefeller Foundation such financial support as to assure it adequate buildings and a sufficient working income. Plans for the laboratory, docks, etc., are in preparation, and the Trustees, the initial board of whom has Dr. Lillie as President and Dr. Bigelow as Director, hope to open the Institution by the summer of 1931.

THE YELLOWSTONE CANYON, WYOMING

The Yellowstone Canyon through which the Yellowstone river flows on its way from Yellowstone lake to join the Missouri, and said to be the most beautiful in form and colouring of the many remarkable canyons of the Rocky Mountains, is described by Dr. O. T. Jones, Professor of Geology in Manchester University, in an article entitled "The Secret of the Yellowstone Canyon," published in *Discovery* for February 1930. The article is the outcome of a visit which Dr. Jones made to the Yellowstone district in the summer of 1928 in company with Prof. R. Field, of the University of Princeton.

The canyon is in the Yellowstone National Park of North-West Wyoming, a tract about equal to the combined area of Lancashire and Cumberland. The region bears abundant marks of former volcanic commotion, and numerous hot springs and geysers in the Park testify that volcanic activity has not yet entirely

ceased. The Yellowstone Canyon contains falls which are a normal feature of canyons and are considered to mark the point to which the renewed erosion following the elevation or uplift to which the canyon is due has extended.

The singularity of the Yellowstone Canyon, however, is concerned with the presence below one of the big falls of silts and sediments, to a large extent forming the actual walls of the canyon, which bear every indication of having been laid down in comparatively still water. Yet the part of the canyon near the falls in question offers no reason for the formation of a lake on the site of the pre-existing canyon. A clue however was obtained some 24 miles lower down in the neighbourhood of Tower Falls, where a striking feature of the canyon is a great sheet of basaltic lava. Examination has led the investigators to conclude that the basalt flowed into the Yellowstone valley against the direction of drainage, forming a barrier or dam which would impound the water upstream between the lava and the walls of the canyon. Dr. Jones concludes from all the evidence available that the erosion of the Yellowstone Canyon as well as its subsequent infilling was effected long before the Ice Age, probably during the Pliocene period. The lake above the lava dam, also formed in that era, arrested the development of the canyon. Erosion in post-glacial times has only just proceeded far enough to remove most of the infilled sediments, and the fall now stands nearly where it stood during the Pliocene. Hence Yellowstone Canyon is an example of a canyon arrested in its development for a long period, and the existing phenomenon may be regarded as a resurrected canyon.

DISTRIBUTION OF WOODLAND AND SCRUB IN SOUTHERN CHILE

A further instalment of the *Geographische Abhandlungen*, edited by Norbent Krebs, in continuation of the series by Albert Penck, has appeared, in the form of a monograph by Dr. Otto Berninger, entitled "Wald und offenes Land in Süd-Chile seit der spanischen Eroberung" (1929). This work is an important contribution to the scientific literature of Chile. Although of special interest to the botanist, questions of geology and meteorology and of the occupation of the land, first by Spaniards and then by German colonists in 1850, are discussed in detail and with numerous references to many authorities. In a map described as an *Orographische skizze*, the author shows the limits of the three main physiographic regions of Southern Chile: the wall-like coast range, the flat-bottomed valley, and the parallel ranges of the Andes, and, further, distinguishes between level and broken country in the valley and between well-defined and ill-defined margins of the coastal range. Detailed descriptions in the text of the Central Valley from the Biobio to Reloncavi and of the peninsula of Arauco contain geological observations of real value. Climatic data are given, but no attempt is made to indicate their significance in relation to the distribution of vegetation, a serious omission in such a work. Two interesting rainfall maps require a little explanation. One, after Jefferson (1921), is based upon actual falls, reduced to period, but with no allowance for known or assumed effects of relief upon precipitation; the other, after Edwards and Knoche (1929), gives an intelligent estimation of probable falls in the Andean area, which is largely without data, and, compared with Jefferson's map, shows a considerable increase in detail consequent upon an increased number of stations (Knoche, "Jahres- Januar- und Juli Niederschlagskarte der Republik Chile," *Z. Ges. E. Berlin*. Nr. 5/6, 1929). Two cloud maps, also after Knoche ("Karten der Januar- und Julibewölkung in Chile," *Z. Ges. E. Berlin*, 1927), showing summer and winter conditions, are also given, though the author makes no mention of their relevance to his argument.

The present distribution of plant associations is shown on an excellent map, which is an important contribution to plant geography. A point of special interest in this area is the manner in which the rich jungle of the lower Andine slopes gradually dies out in the Araucaria forests. Above these forests, which are clearly defined and described, there is a region of dwarfed shrubs (*Nothofagus pumilio*). Dr. Berninger finally attempts to reconstruct on a map the distribution of wood and scrub land in Southern Chile before the entry in 1850 of the German colonists, who started a systematic development of the country. In spite, however, of the immense amount of careful research into Spanish, German, and Chilean records, as well as personal investigation in the region, it is doubtful if the problem has yet been satisfactorily solved. Too many variable factors are involved: such questions as to what was the original population of this part of Chile, and how many Araucaria Indians were killed in war or perished by famine between 1560 and 1850; or complications such as primitive methods of forest agriculture and the advance of the wood-cutter in recent as well as former times. The illustrations, especially those of various types of vegetation, are excellent.

THE EMPIRE AND AGRICULTURE

At the Conference of Empire meteorologists held in London last August a number of papers were read and discussed bearing on the agricultural side of meteorology in the British Empire, and a report of these papers has recently been published. (Conference of Empire Meteorologists, 1929. Agricultural Section. II. Papers and Discussions. London. H.M. Stationery Office, 1929.) The opening paper by the Chairman of the Conference, Sir Napier Shaw, gives a brief historical review of agricultural meteorology, and emphasizes the importance of the modern development of scientific agriculture, as indicated by experimental stations and training colleges, if the best use is to be made of the soils of the Empire. Hitherto agricultural meteorology has been, to quote Sir Napier, "what the farmer knows but won't say"—or perhaps, cannot formulate, since much of his weather lore in relation to crops is instinctive. The various papers and discussions thereof, on different aspects of the relations between weather and crops in all parts of the Empire, reveal to the fullest extent the complexity of the subject, which is not due simply to the large number of atmospheric and soil factors involved, but still more to the fact that the various factors are interrelated in such a way that the effect produced by one is markedly dependent on the intensity of the others. A further complication is due to lag in the effect of weather conditions, for the yield of a crop may be largely determined by weather that is long past.

The importance of the action of light, in regard not only to intensity but also to quality, is emphasized in many papers, though unfortunately the effect of this factor is not generally so well understood as is that of the other climatic factors. Thus Dr. W. P. G. Atkins and Dr. H. H. Poole on "Methods for the Photo-electric and Photo-Chemical measurement of Daylight" observe truly how the idea of the importance of temperature has dominated all other considerations in studies of the distribution of vegetation over the globe. Among other subjects discussed are the optimum amounts of rainfall for a large number of products in the several tropical colonies, and the damage to fruit crops by spring frosts in England and other of the colder countries of the Empire.

IMPORTANCE OF WEATHER CYCLES IN HYDROLOGY

Though an immense amount of labour has been expended by various meteorologists in bringing to light rainfall and other weather periodicities in agreement with the sun-spot period of eleven years, the Brückner cycle of thirty-five years and so forth, their results have never made very much impression upon meteorolo-

gists in general because all such weather cycles are very weak in comparison with the irregular changes of weather and are no use in the practical problem of forecasting. In a paper, however, contributed by A. Streifl to the *Monthly Weather Review* for October 1927 under the title "Practical Importance of Climatic Cycles in Engineering," it is pointed out that faint climatic cycles, though of little significance in meteorology, may be of great importance in hydraulic engineering, and that to neglect "climatic engineering" is to court the risk of loss of life and property. This difference between meteorology and hydrology is due to the fact that drainage basins both accumulate and amplify the effects of slight variations of rainfall, and that a run of somewhat drier or wetter years, in so far as these were due solely to position in a regular cycle that would make little impression in general weather experience, would produce very noticeable effects on the rivers of a country.

Thus if the rainfall increased only by one-third the run-off might easily be doubled. The author cites the case of the Great Lakes of North America which on the strength of the usual rainfall cycles in question are expected to expand by about 1940. This will provide more water for power purposes and hence benefit hydro-electric undertakings, but at the same time it will inconvenience lake-side dwellers, whose houses would not be where they are had they been designed in the light of "climatic engineering."

On the same principles, again, Great Salt Lake fell 14 feet between 1875 and 1905, despite the fact that the weather during that period appeared very much as usual. Curves are produced by the author illustrating the fluctuations of lake-levels in different parts of the world in relation to sunspot periods, but there is no specific reference to the remarkable case of the East African Lakes investigated by Dr. Brooks (see *Journal*, 63, 1924, p. 267).

MEETINGS: SESSION 1929–1930

Fifth Afternoon Meeting, 17 March 1930. The President in the Chair

Paper: Hydro-electric Power Development in New Zealand. By Mr. R. O. Buchanan

Tenth Evening Meeting, 24 March 1930. The President in the Chair

Elections: Robert South Barrett; Commr. J. A. Bickford-Smith, R.N.; Lt.-Commr. William George Albert Bourne, R.N., A.I.N.A.; George Graham Brown; R. J. Buxton; John Henry Charles Byrnes, B.A.; Mrs. Marie Louise Emma Carson; Reginald D. Chivers; Miss Kathleen Mary Dallimore; Miss Dorothy M. A. Dickinson, B.A.; C. Van Hemert Engert; Bernard Edmund Evans; Capt. Geoffrey Milner Le Hain; Mrs. Olive Rubens; Eric Earle Shipton; Sam Steane; Herbert Stevens; John Anthony Story; Stephen French Whitman; Dr. John A. Widtsoe; George Arthur Willetts; Lieut. Adam Tyrie Wilson-Brand

Paper: Exploration in the Eastern Karakoram and Western Kunlun. By Dr. Emil Trinkler

Eleventh Evening Meeting, 7 April 1930. The President in the Chair

Elections: Thomas Arthur Armstrong; Herbert Brewer; The Rev. Harry Herbert Heap, M.A.; Miss E. J. Lindgren; B. Oscar Malling Mamen; Mrs. Louise Newman; Herr. Karl Roll; Mrs. P. Tremlett; Douglas Hugh Francis Wilson; Mrs. Margaret Hicks Williams

Paper: North-Western Manchuria and the Reindeer-Tungus. By Miss E. J. Lindgren